OUTLINES

OF

PSYCHOLOGY

DICTATIONS FROM LECTURES

—BY—

HERMANN LOTZE

TRANSLATED, WITH A CHAPTER ON

THE ANATOMY OF THE BRAIN

—BY—

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PREFACE.

The translation of Lotze's *Grundzuege der Psychologie*, which forms the principal part of this book, was made in 1882, and it was expected to publish it at once. Circumstances prevented, for the time, the carrying out of the plan, but lately a personal need of some small text book to use in connection with the study of comparative anatomy in the scientific department of an undergraduate course led to its revival. This circumstance explains why the short chapter on anatomy has been appended unnecessarily, as it may seem. It is believed that, in its present form, this volume will prove convenient: firstly, for use in connection with the little that can usually be said upon the physiology of the nervous system in the comparative anatomy of our ordinary colleges, at the same time furnishing a thoroughly reliable foundation upon which to add the more extended work in psychology: secondly, as a first book of psychology where for any reason the physiological side does not receive special attention in the philosophical department. Of the value of Lotze's little work nothing need be said here, the great German philosopher is rapidly gaining recognition even in

America, while the series of "Outlines," of which this forms a part, has been exceedingly well received abroad. Attention may be asked, however, to the fact that these are but *outlines*, and embrace but the dictated portions of an extended lecture course. Their use in the school room implies oral explanation and illustration, or, better, they may form the frame work for a lecture course which may deal as fully with anatomical and physiological details as time permits. It is a matter of regret that no English work in this department has as yet appeared which is not devoted to the indirect inculcation of a theory (unorthodox or otherwise), or for some other reason unadapted to place in the hands of college students. Of the writer's part of the work it is not becoming to speak further than to express the hope that the sacrifice of literal accuracy will be found to have been attended with compensating advantages in perspicuity. The very forcible and colloquial style, which is so striking in the original, is very hard to imitate, and one may be satisfied if the attempt prove intelligible.

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INTRODUCTION.

Sensations, conceptions, feelings, and acts of will constitute the group of familiar facts which we are accustomed to designate, although with a reservation in view of future discoveries, as the life of a peculiar being—*the soul*.

In order to fully meet our scientific requirements it is necessary, *first*, through the agency of observation, to completely set forth all the individual elements of this life and the general formulas for their combination—*Descriptive* or *Empirical Psychology; secondly*, to specify the nature of the subject in which this life subsists as well as those active forces and conditions by which this life is produced and caused to maintain that course with which experience has made us familiar—*Explanatory* or *Metaphysical Psychology; finally*, to give a rational explanation why all these facts exist, or, in general, the mission of soul-life in the world—*Ideal* or *Speculative Psychology*. Now since the latter problem does not admit of a solution in strict scientific form, while the treatment of the first is easily combined with that of the second, the question with which we are chiefly concerned is this: "Under what conditions and

by means of what forces are the single processes of spiritual life produced: how are they united with, and modified by each other so as to produce, through their combined activity, the total of spiritual life."

Our course is that offered by the phenomena themselves, that is, we begin with external impressions, by which the spiritual activity is excited from moment to moment afresh, then consider the manifold internal transformations which these impressions undergo, lastly the reflex activities—motions or other acts—which result from them.

Only after the enumeration of these individual elements of the spiritual life is it possible to pass to a comprehensive consideration of the nature of that subject which controls this life.

PART FIRST.

The Individual Elements of the Inner Life.

CHAPTER FIRST.

SIMPLE SENSATIONS.

§1. We here understand by simple sensations those which evince no combination of similar or dis-similar parts, and we, furthermore, assume them to be induced (as is usually the case) by external impressions.

In this case we distinguish in the production of a sensation, as the first process, the *external sense excitement*. No object becomes, by virtue of its existence simply, an object of apprehension; it becomes such only as it either itself approaches to contact with our body, as in the case of impact, or communicates to the surrounding medium motions which extend from element to element until at length they reach our body, as is the case with sound and light waves.

In all cases, however, the external sensory stimulus is a motion of some sort or other and has no similarity to the mental processes which are evoked by it.

§2. The second essential is that process *within* the body which is caused by the external excitement. By their contact with the body these external irritants produce manifold changes in the external layers, of which we know little, and which we do not need to follow

psychologically because they can only become the sources of sensation when they reach the ends of the nerves distributed throughout the body. In them an excitement is produced which must extend through the entire length of the nerve-thread to the brain before a sensation can be produced.

An injury of the nerve, which prevents this transmission, results in the complete loss to consciousness of knowledge of the irritations in the peripheral nerve termini.

In what that excitement known as the nervous action consists is not definitely ascertained, but it is only important in psychology to answer the question whether this is simply a sort of physical motion or whether it already participates in the character of psychical life.

Sensation does not simply exist at large in the nerves but we must explain just what it is that is affected by the sensation. The nerve as a whole it cannot be, for the nerve is an aggregate of many parts and, moreover, is never, as a whole, in a state of excitement but, on the contrary, one part is affected after another successively.

It would therefore be necessary to assume that each indivisible atom of the nerve is a sensitive subject and each transmits its sensation to its neighbor until at last it reaches the soul.

The fact that the transmission of the excitement may be prevented by alterations in the physical continuity of the nerve, as, for example, by incision, shows that

this transmission is the result, not of an immediate sympathy, but of a physical effect produced upon one nerve atom by another.

Then we must suppose that the atom **a** acts physically upon the atom **b** and, as a result of this action, **b** enters the state of sensation **E.** Then atom **b** imparts a physical impulse to atom **c** which thus, in turn, becomes affected by the sensation **E.** The last nerve atom **z** acts then, in a way entirely unknown, upon the soul and now this also is so excited as to produce its sensation **E.**

It is easy to see that this last impulse, by means of which our sensation (which is, after all, the only thing of which we really know anything) is produced, would have exactly the same result if the nerve atoms exerted simply a physical influence upon each other and if their own sensations (which are simply assumptions and not discovered facts) did not exist at all. Since the idea of sensation in the nerves themselves contributes nothing to the explanation of our own sensations, and, moreover, is not demonstrable, while the passage of a physical impulse can not be denied, we shall, in the future, consider the nervous action as simply physical motion which passes from one nerve element to another and which does not partake of the psychical nature characteristic of the resulting sensation.

§3. The third link in this chain of processes is that

condition of consciousness so familiar to all, the *sensation* itself—the act of seeing a light of a definite color or the hearing of a sound, for example.

Of the two elements in this process which we are able to distinguish in our thinking, namely the qualitative content, which we perceive, and the perceiving activity by which it is made known to us, neither the one or the other is comparable with the nature of the external excitement or the nerve process. As accurately as we may analyze the nature of ether waves we never discover in them the reason why they are seen as light rather than heard as sound, nor why one sort is perceived as red and another as blue and not the reverse. Furthermore, however we may combine the physical motions of nerve atoms there never comes a point where it is clear that the motion last produced is not to remain motion but must pass over into the entirely different process of sensation.

Vain are all attempts to discover how it is that the simple physical motion gradually passes over into sensation. We must, the rather, be content to state that nature has, by one of its imposed necessities, quite unknown to us, so correllated these two dissimilar series of processes—motions and sensations—(which we are unable to derive the one from the other) that a member of the one series always produces a definite member of the other.

§4. It would be assumed that these two series of processes would not be linked together without system, but rather that similar excitements in one series would correspond to similar sensations in the other and different excitements to different sensations. And, when, in the series of stimuli, a definite progress, retardation, periodicity, or prominent elements occur it would be expected that, in some way, all these would find expression in the corresponding series of sensations.

This assumption is but partially supported by experience. In the first place, the various classes of sensations (colors, sounds, odors) occur serially one after the other, forming no complete system. It does not in the least follow because we perceive ether waves as light that we must perceive air waves as sound. The same is true of the individual elements of the different classes. He whose experience of taste and sight was limited to the taste sour and the color yellow would not be led to suspect the existence of bitter and blue.

Again, it is only in the case of sounds that we find a definite progression in the series of excitements corresponding to a similar progressive arrangement of the series of sensations: the pitch of sounds increasing with the rapidity of the vibrations of the sound waves. It should here be noticed that the manner in which the sensations reflect the variation in the exciting cause is itself quite peculiar. The difference in pitch between two tones has no similarity to the difference between

two numbers, but expresses an entirely peculiar increase of qualitative intensity which could not have been expected and of which we have no other illustration.

In like manner the remarkable instance of the doubling of the number of waves finds a peculiar expression in the octave, which is not perceived as the doubling of anything but as a remarkable combination of identity and dissimilarity between the tones unexemplified elsewhere.

On the other hand colors, although they correspond in their prismatic arrangement to a similarly increasing wave-rate, do not at all arrange their impressions in a series of increasing intensity. This discrepancy results from the fact that we can only legitimately expect a correspondence between sensations and their immediate causes—the nerve-processes. The latter, however, we do not understand, and are forced to compare, in all cases, only the results of sensation with the external stimulus upon which, as we saw, they do not immediately depend.

Finally, since our sensations do not form a perfect system, it is possible that the realm of sensations is not exhausted by our senses but that other animal souls may exist with entirely different, although, of course, to us unknown, forms of sensation.

§5. The duration of sensation can be roughly compared, in general, to that of the nerve process which

produces it. For we find, under ordinary circumstances, that it never continues longer than the duration of the external irritation, unless the latter leaves behind enduring effects without or within us, which themselves constitute the stimulus for new sensations.

Strictly speaking, however, an excitement of the nerve, once produced, cannot cease of itself but must be interrupted by active opposition. This is usually furnished during health by the continuous activity of the nutritive process, by means of which the normal and indifferent condition of the nerves is restored and they thus prepared to impartially receive new impressions.

Very generally, however, not only when the irritation is very severe but particularly in the case of the sense of sight, the process may not be rapid enough. Then we have continuous or sometimes periodical excitations corresponding to the well-known illusions, *i. e.*, actual sensations, which, if active enough, prevent the sense from receiving new impressions. An example of this is furnished by the brilliant figures produced by looking at the sun.

§6. Every day experience, as, for example, observation of an approaching light or of an expiring sound, shows that we are, in general, very sensitive to small differences in the intensity of the stimuli of sense. They are, however, only perceived as *more* or *less* intense and the moment never comes when we can affirm,

from the evidence furnished by the impression simply, that one light is half as bright or one sound half as loud as another.

This circumstance prevents us from finding, by the most direct method, the exact law governing the dependence of the sensation upon the intensity of the stimulus.

We can, indeed, easily arrange a series of irritations which admit of an accurate measurement of their various intensities but we can not, by means of the observation of the intensity of our own sensation corresponding to them, refer to each its value in numbers. We can not, therefore, derive from the comparison of these two sets of values the general law which suffices for all. We are, therefore, driven to the following circumlocution, depending on the fortunate circumstance that we are at least able to judge with a high degree of accuracy and certainty of the likeness of two sensations. According to the fundamental experiments of Ernst Heinrich Weber (article "Sense of touch and sensation" in R. Wagner's *Dictionary of Physiology*, vol. III, part 2.) which have since been confirmed and extended by many others, two similar excitements, when they begin to vary, do not produce two evidently distinguishable (instead of identical) sensations until their intensities stand in a definite geometric ratio. This ratio remains the same for one and the same sense, within the limits, of course, of irritations so small as

not to awaken the nerve and so violent as to disturb the function. On the other hand it is different for different senses, approaching about 3 : 4 for the hearing and simple feeling of pressure upon the skin: 15 : 16 for the latter when supplemented by muscular sensation in lifting; 100 : 101 for sensations of light.

§7. The dependence of our capacity for distinguishing impressions upon the ratio of the intensity of the irritation, which has been derived from observation, is embodied in *Weber's Law*.

It does not explain, however, in what way the ratio of the intensity of the irritation really prepares us to distinguish impressions.

It does not explain, namely, whether the variations in the intensity of the irritations produce a noticable difference in the *intensity* of sensations, these otherwise remaining the same, or whether they produce sensations *qualitatively* different, and which are in this way distinguished.

In itself, every sensation is a single indivisible act. To separate in thought as distinct elements the qualitative content and the intensity with which it is perceived is indubitably permissible in so far as the immediate impression, with regard to which we can alone decide, agrees with it. This is, for example, the case with sounds. Here we may really convince ourselves that a sound of definite pitch and timbre may become louder

or fainter without altering its character on this account.

On the other hand, it is quite questionable if the sensation of a heavy pressure is the same as that of a lighter one, or if the taste of a concentrated acid is really the same taste as that of a more dilute acid of the same kind. Still more reluctant are we to consider the sensation of cold as simply that of a feebler heat. Both are, rather, opposite poles, although the agencies producing them are similar processes.

Finally, various intensities of light have really various colors; a less brilliant white is not simply pale white, but it has become gray, and this gray, as well as black, cannot be considered as simply a feebler sensation of white. These points have been overlooked hitherto and not disposed of.

The following discussion depends upon the assumption, which, although unproven, may be correct, that sensations are distinguished because their intensities vary according to a definite scale.

§8. It must be first remembered that for each sense a certain small irritation is necessary before a sensation can result. Naturally, in order to explain this circumstance, which is not at all self-evident, a resistance of some sort must be assumed by reason of which a very small irritation is prevented from affecting the mind. Where this resistance is offered is not known.

It is farther assumed that the passage from complete

identity or imperceptible difference in two impressions to a difference just distinguishable is always one and the same constant increment of the sensation (*i. e.*, of the second impression as compared to the first) and that the minuteness of the distinction, may, therefore, be employed as a scale for measuring the intensity of the sensation.

It may be inquired, how must the irritation increase so that the passage from one value of it to another may always produce a constant increment in the intensity of sensation. According to the experiments referred to the answer is this: In order that the intensity of the sensation may increase by a constant difference, *i. e.*, in arithmetical ratio, the intensity of the irritation must be increased much more rapidly, *i. e.*, in geometrical ratio; or, the relation of the first to the second is comparable to that of a logarithm to the number of which it is the logarithm; more simply expressed, sensation belongs to that class of activities which rise in intensity with greater difficulty the more intense the activity they are already exerting.

The following questions remain to answer:—

1. Why this peculiar relation occurs at all, and why the sensation and the irritation are not, the rather, directly proportional, which would seem more natural? None of the theories offered is satisfactory, but the most plausible assumption is that, in the transformation of

the external irritation, something or other takes place which proceeds slower as the irritation increases.

2. But why is it that all impressions are not distinguished—that, for example, a weight 3 must increase to 4 in order to produce an additional sensation of pressure and none is produced by $3\frac{1}{4}$, $3\frac{1}{2}$, or $3\frac{3}{4}$? Certain arrangements can be easily thought of by which this discontinuity in the series of sensations could be produced but it is not in the least known where or how in the body or soul such arrangements are situated.

Both these riddles are quite unsolved.

(Comp. *G. Th. Fechner*, Elements of Psycho-physics. Leipzig, 1860.

G. E. Mueller, Foundation of Psycho-physics, Berlin, 1878.)

§9. It may, perhaps, be claimed that a state of rest or an entirely unvaried excitement is never the immediate occasion of sensation, but that the passage from one condition to another is always necessary. From this it would follow that sensations which may continue to us for a long time, for example, the seeing of a light or the hearing of a sound, must be based on series of single impulses with intervening pauses so that here also a frequent repetition of alterations between excitement and a state of rest would occur.

In the case of sensations of light and sound this can be proven. Here even every single flash of light and

every shortest sound consists of a considerable number of discrete impulses which are transferred to the organs of sense. In the case of the other senses this evidence is wanting.

If it be said that all processes of stimulation which are to produce sensations must have the form of oscillations between two opposite conditions, it, at least, must not be understood that the sensation consists in the enumeration of these impulses. They can only be regarded simply as the actual conditions upon which the origin of sensation in an unknown way depends. In the content of sensation itself—in redness or warmth—we discover no motion whatever and still less the number of the oscillations by reason of which it becomes the cause of sensation.

§10. If an excitement **a**, which is ordinarily produced by the operation of an external irritant and which is followed by the sensation **A**, be exceptionally produced by an irritant arising within the body then the same sensation **A** will follow: this is called *subjective sensation*.

Common examples are the ringing in the ear, flashes of light in the eye, and fever chills and heat.

In connection with this stands the theory of the *specific energy* of the nerve according to which each individual sensory nerve always produces the same sensation however it may be irritated. If it were so, it would not be strange, for every connected system of parts

which is disturbed but not destroyed reacts in attempts to regain its equilibrium, the form of which re-action, depending upon its own structure and its inherent active forces, is not altered by the diversity of the disturbing irritants. But, in that case, since this attempt in one nerve is distinguishable from that in every other, each nerve must have its own peculiar structure, a condition which we have not, as yet, discovered.

There are no facts, however, which require to be thus explained. We simply know that light stimuli, blows, pressure and the passage of electrical currents through the eye waken sensations of light, and, perhaps, that blows and electricity produce sensations of sound, and the latter of taste.

Now a motion of the ponderable portion of the elastic globe of the eye can hardly take place as the result of a blow without its being followed by a translation of a part of it into motions of the ether within it, thus producing light waves which would constitute as sufficient an irritant to affect the optic nerve as if they came from without.

In like manner, a blow may impart to tense membranes and organs vibrations which then constitute normal stimuli to the auditory nerve equally with sound waves from without.

Finally, the electric current produces certain chemical decompositions of the fluids of the mouth in which are to be found sufficient irritants to affect the gustatory nerve.

Hence it may be maintained that in order that the nerve should reach the condition **a** which is followed by the sensation **A** a definite adequate irritation is necessary, but very many inadequate irritants exist which subdivide in their operation into various components, one of which may be an irritant adequate to produce the sensation **A**, others being perceived at the same time in other sensations, as, for example, the simultaneous feeling of pain in case of a blow.

§11. The operation of the external irritation is not as simple as formerly supposed: waves of light not acting, for example, directly upon the optic nerves to awaken according to their constitution all possible color and light sensations. There are found in the eye peculiarly constructed layers, as yet not well understood (rod and spindle layers) which appear to be designed to translate the light waves entering them into chemical changes in a peculiar substance (optic-purple) which then act as irritants upon the optic nerve. In the skin and tongue we likewise find peculiar tactile and gustatory organs, which, in some unknown way, are supposed to give to the irritation the definite character necessary to affect the nerves contained in them.

In the ear we find something analogous, although here the simpler arrangement seems to prevail, each single nerve-fibre being receptive only to a single tone. The entire expanse of the fibres (in the organ of Corti)

is thus like a piano and each thread receptive to only one rate of vibration.

A similar hypothesis is in vogue as to the eye. According to this theory there are three sorts of threads, of which each is irritated independently, and each is sensitive to one of the three fundamental colors—green, red, and violet. The other colors result from the simultaneous irritation of threads of the other sorts.

This hypothesis is not invented gratuitously, but to account for the phenomena of *color-blindness* which are explained by it.

It is necessary to explain, however, why a definite combination of simultaneous excitements can produce from red, green and violet, the other colors, as yellow, blue, and red, which, so far as the impressions of sensation are concerned, seem not at all likely to be derived from them.

§12. In one sense, *all* sensations are but subjective, *i. e.*, only appearances in our consciousness which have nothing corresponding to them in the external world. Even in antiquity this truth was outlined, and modern physics fills out the picture. The external world is neither silent nor loud, neither bright nor dark, but is as utterly incomparable to these as is sweetness to a line. Nothing is happening outside of our bodies but motions of various sorts.

Physiology often makes the untenable statement that

sensations are simply apprehensions of our own condition. All that goes on in the nerves while we are seeing is not in the least perceived by us, and there is known no process in our souls preceding the sensation so intimately that it may be called an act of perception of the sensation. It may be said, therefore, that sensations are appearances within us which are, indeed, the results of external irritations, but are not strictly representations of them.

The proofs upon which this theory rests, all, admit of evasion. It may be still assumed that things are really red or sweet, but we cannot know them to be so except as they cause motions to operate upon us which certainly are neither red nor sweet, but cause to arise in our minds the same redness and sweetness, *as sensations*, that really are peculiarities of things. The real proof is that such objective peculiarities are unthinkable. Wherein consists the brightness of a light which no one ever saw, or the sound of a tone no one has heard is quite as impossible to say, as what a toothache would be which no one ever had.

It is, therefore, part of the very nature of colors, sounds, odors, etc., to be limited to a single position and a single occasion. They can, namely, only exist in the consciousness of a soul, and then only when the sensation is felt.

CHAPTER SECOND.

THE PROCESS OF CONCEPTION.

§1. Concepts, in contrast to sensations, are those pictures of memory which are left in consciousness by earlier sensations.

This agrees with our ordinary use of language; we conceive of the absent, which we do not perceive, but perceive the present which do not require to conceive of. Conception is peculiarly distinguished from sensation. The concept of the brightest light does not gleam, of the loudest tone does not resound, of the acutest pain does not ache. In each case, however, the concept accurately represents the gleam, the sound and the pain which it does not really reproduce.

§2. These pictures of memory are not *always* present in consciousness in this form. They appear only now and then, but, when they do, in such a way that no external irritation is necessary for their reproduction. It follows that they were not entirely lost in the meantime, but must have transformed themselves into some conditions, which we cannot, of course, describe, but for which we may employ the contradictory but convenient name, "unconscious concepts," to indicate

that they are formed from concepts and, under proper circumstances, may again become concepts. The study of the process of conception must explain both these states.

§3. The disappearance of concepts from the consciousness no one can observe: we can speak only upon the basis of decisions drawn from what we find in consciousness afterwards, and upon general principles.

Two views stood opposed to each other. It was formerly thought that the disappearance of concepts is quite natural, and that the opposite—*memory*—requires explanation. Now, however, following the analogy of the physical law of inertia, it is thought necessary to explain *forgetting*, because the continuance of an excited condition is self-evident.

This analogy is rather lame. It applies to the motions of bodies, but motion is only an alteration in external relations by which the moved body does not suffer, because it is situated exactly as favorably in one place as the other, and has neither cause nor standard for putting forth a resistance to the motion. The soul, on the contrary, is placed in various internal conditions according as **a**, or **b**, or nothing is conceived. It is conceivable that it reacts against each of the impressions offered, and thus, without annihilating any of them may, perhaps, change them from conscious sensations into unconscious states.

Even the principle of the *unity of the soul*, admissible as it is in itself—even this unity, which makes necessary the reflex action between the many conceptions, so that one must replace the other—does not lead us to the goal. For, if it be asked in what way the soul, in its unity, utilizes the plurality of concepts, the most reasonable assumption would be that all qualitatively diverse sensations or concepts are fused in a single homogeneous intermediate condition.

Yet this is not the case, but the concepts, for example, of blue and yellow, or large and small, when once originated in the consciousness as distinct, never mingle. It is also clear that all the higher spiritual products, which consist chiefly of relations between different points which are to be compared, would be impossible if, in this fusing into a common condition, the diversity of the different points were lost.

The following thoughts are suggested simply as hypotheses which are not deducible from principles.

§4. According to the analogy of physical mechanics, concepts might be considered as forces which operate upon each other according to the degree of their resistance and intensity. Both parts of this hypothesis are difficult to support by experience. In regard, firstly, to the intensity, this notion is employable in the case of *sensations*, in as far as the greater perceived content is an effect of the greater activity of sen-

sation, or a more severe agitation or affection of the perceiving subject. But the simple concept of a bright light is no greater than that of a feeble shimmer, and that of thunder requires no greater effort than that of a slight noise.

The conceiving activity seems then to permit of no distinction in intensity, but this must be found alone in the conceived content.

Moreover, the more or less obscure concepts, which we think we have of one and the same content, by no means produce a diverse intensity of the conception.

Simple concepts which seem obscure to us, as, for example, that of the taste of a rare fruit, we do not have at all, but simply know, from other sources, that the fruit has a taste. The greater the field within which a choice is possible between various tastes without reaching a decision, so much the more obscure appears the concept of the real taste which we are seeking but do not possess.

Complex concepts, such as pictures of external objects or scientific formulæ, are not obscure because the entire content becomes gradually fainter, but because it becomes discontinuous. Single portions drop out entirely, but, particularly, the definite relations in which the remaining constituents stand to each other are forgotten. The greater the number of the possible connections between which one hesitates, the greater the, so-called, obscurity of the concept. On the other hand, as soon

as a concept is thought complete in all its parts and connections, it is not possible to conceive it more or less vividly. The increase in clearness which seems to result from the association by research with the concept, say of a triangle, of the many other thoughts unknown to the beginner, is but apparent.

§5 The second of the notions employed, that of resistence, awakens the question whether it refers to the *content* of the concept, or to the activity by which it is conceived. These are not identical. Concepts are never that which they represent, that of red is not red, that of a triangle is no triangle, that of passion is not a passionate concept.

If two conceived contents oppose one another, as right and left, plus and minus, black and white, it does not, in the least, follow that the conceiving activities which produced them are also opposed, and so, according to the analogy of opposed physical motion, would tend to neutralize each other.

§6. The notions of intensity and reaction would only be applicable to the founding of a system of psychical mechanics if they could be referred to the conceiving activity.

This is not the case. It could merely be accepted as a fact, if the intensity and reaction of conceived contents were the causes of the alterations of conception.

Experience does not confirm this: conceptions of larger contents by no means displace those of smaller. On the contrary, the latter are sometimes in a position to suppress even the sensations of external irritation.

Now concepts never enter the soul without doing something else: connected with every impression is that which is conceived to be its result, and also a sense of the value which it has for the physical and spiritual well-being of the one perceiving.

These feelings of pleasure and displeasure are just as capable of gradual diminution as the simple conception is incapable of it. This feeling of participation is susceptible to great variations dependant upon variations in the state of mind, and according to the amount of this feeling of participation, or, briefly stated, according to the amount of interest which a concept, for various reasons, excites in the soul at each instant, it operates with greater or less force to suppress other concepts. It is in this, rather than any inherent peculiarity which the concept has, that what we call the power of the concept consists.

§7. The second question was, how do concepts return into consciousness? With regard to this, it is simply known that a concept, **b**, very frequently returns if another, **a**, be produced in consciousness.

As, however, not any **b** appears as a result of the presence of any **a** we please, there must be a more in-

timate connection between those which reproduce each other than exists between those which do not so reproduce each other. This connection is called *association*—a simple name which does not in the least express in what the connection consists. Likewise is *reproduction* a simple name for the fact that a given **a** recalls into consciousness **b**, which is associated with it.

Nevertheless, the conditions under which both association and reproduction actually take place may be studied.

The two primary classes which are usually first mentioned, *i. e.*, reproduction, on the one hand, of likes by like, and, on the other, of opposites by opposed concepts, are not readily supported by experience. For it cannot be said that a sound or color recalls more vividly all other sounds and colors than some other concepts. If, on the other hand, opposites remind of each other, as darkness of light, night of day, plus of minus; the reason is not their opposition alone, but the special importance which these have for our life or its activities, so that we are thus reminded of the one by the other.

But the third and fourth cases, the reproduction of parts of bodies occupying space by other parts and, on the other hand, the mutual reproduction of the parts of a successive whole, as, for example, a melody in its original order, do certainly occur.

Examples are unnecessary. Neither does it seem necessary to refer the third case, as is often done, back to

the fourth, because, it is said, the perception of a simultaneous whole takes place in a successive manner, the eye requiring to run over the whole and thus gradually perceiving the connection of each several part with the next. We do, indeed, form accurate images only in this way, but it is not to be denied that an instantaneous glance may form images of which the single parts are capable of reproducing each other.

The facts may, therefore, be thus summarized:—

Every pair of concepts, whatever their content, associate themselves whenever they are produced simultaneously or one immediately following the other (*i. e.*, without intermediate ones). To this case may be referred without further argument, the special case with which a number of concepts may be repeated in their order but not out of it.

If, finally, *immediate reproduction* be given as a special case, comprising instances where the concept or sensation **a** is again awakened by the influence of a new irritation which produces the same **a**, it must be remembered that the second **a** could not be recognized as a *repetition* of the first if they were really both identical.

The first one, however, which is thus awaked by the second, now reproduces, on its part, those associated circumstances under which it was previously experienced, and these are different from those of the present moment. The recognition of the original **a** is, there-

fore, dependent upon mediated reproduction, *i. e.*, of other concepts through the agency of **a**.

§8. Most concepts, in the course of a lifetime, associate themselves in the same way with many others. If, therefore, a definite **f** is again distinguished in consciousness, it is quite uncertain which of the many others, **g**, **h**, **i**, or **k**, with which it was formerly associated, may now be reproduced.

The basis for the decision in favor of any one lies partly in the course which the concepts prior to **f** have taken, with which **g**, **h**, **i**, and **k** may not equally agree; partly in our mood or the humor produced each moment by the activity or restraints of our being; partly, finally, in the peculiar conditions of the physical life, which we will here omit entirely, but of which we will speak further on.

These views can only be carried out in a general way, it being impossible to base theories upon them which can be carried into details, and equally impossible in an individual case to discover the causes which have really produced the seemingly capricious flow of our thought.

CHAPTER THIRD.

RELATIVE KNOWLEDGE AND ATTENTION.

§1. Up to this time we have spoken of the relations and alterations in conceptions. In our inner life, however, there is, besides these elements, a conception of these relations and vicissitudes. These two things are quite different.

We know that when the concept of blue and red appear at once within us, they, by no means combine to produce violet. If this were the case, the result would be a simple concept taking the place of the others, and a comparison of the two would be made impossible by their disappearance.

Every comparison—in general, every relation between two elements (in this case red and blue)—is evidence that both the factors are distinct, and that a conceiving activity passes from the one, **a**, to the other, **b** and that this alteration which is experienced in passing from the concept of **a** to that of **b** is itself in consciousness. Such an activity we exert when we compare red with blue, and the result is a new concept of qualitative similarity which we accord to both.

If a strong and a weak light are perceived at once, the result is not the sensation of a single light equaling

the sum of them both, but they remain distinct, and in passing again from one to the other we become conscious of another quantitive alteration of our condition, *i. e.*, the simple perception of more or less of the same impression.

Finally, if two identical impressions have appeared within us they do not unite to form a third, but, as we compare them, as above, and do not become conscious during the transition of an alteration in the concept, the new conception of equality arises.

§2. It is important to explain that all these new concepts, which we consider as of a higher order, do not appear as resultants of a mere reciprocation of the original simple concepts in the same way that in mechanics a third movement results from the union of two others. This analogy does not hold good at all in the spiritual realm. The two impressions, **a** and **b**, are rather to be considered as stimuli which operate upon the peculiar and unit nature of a conceiving subject, and, in this, give rise to the reactionary activity through which new concepts, for example, that of similarity, identity, contrariety, etc., result, which would not be produced by a simple combined activity of the separate impressions without the stimulation of this new spiritual activity.

§3. In the same way as these new concept are formed, all of what we call *general notions* are produced.

It is customary to assume that dissimilar constituents of compared concepts neutralize each other by their contradiction, but the remaining similar components constitute directly the abstract part. However, the single examples, out of which we construct a general notion, are not destroyed in the process, but their concepts remain along with the general notion which, as a new product, simply refers to these. Moreover, the general notion never forms a permanent picture which may be conceived of in the same conspicuous way as the single examples from which it is composed. "Color in general" can not be imaged to the mind—it does not look green or red—it does not "look" at all, and just so the concept "animal" produces no distinct image like the concept of a single species. All such general notions are not, therefore, products of the combined operation of many single concepts, for they would then have the same character as their components. The names with which we designate them (such as the word color) are simply conveniences for the conception of a group of single impressions, but with the accessory idea that they refer not to them, but to the common features contained in them, which cannot, however, be separated from them as a similar concept.

§4. Upon this fact depends the various narrower and broader meanings of the word *consciousness*. It often happens that we perceive the plurality of elements, but do

not know how to distinguish at the moment their definite relations. On the other hand, it is possible to become conscious of them later, even after the sensuous impression is past. It follows that these impressions were by no means outside of consciousness, otherwise we could not remember them afterwards. But the faculty of comparison, which enumerates and conceives of the relations actually existing between them was not exerted. It is seen from this that the two operations are separable.

The process of comparison, as the higher, can not be employed without the simple perception of the sensation, but the lower is not necessarily accompanied by the higher.

Common experience shows that there are many circumstances which prevent the appearance of this higher activity. In many emotions we hear the sounds but do not understand the words; or, understand the words but not the significance which they have for us. Even bodily and some little understood conditions cause that the simple sensation of impressions persist while neither their external nor internal connection reaches our consciousness (mind-blindness).

§5. What we have above mentioned is nothing, in reality, but a series of various degrees of *attention*. This was formerly considered as an activity of the soul which, like a departing and approaching light, illumin-

ates, more or less brilliantly, the impression, while it is of itself unperceived. Later this idea of an activity was entirely rejected (Herbart), and the statement was made that the fact that we are attentive to something signifies simply that the concept of this something rises in our consciousness by its own intensity.

We cannot accept the latter assumption, nor can we admit the statement that attention is simply a more intense illumination of the content. We attain anything through the agency of attention only when the conceived content affords opportunity for the operation of our faculty of reference and comparison.

Even a simple content is compared by us at least with other simple contents, or with itself in different moments of its duration. We learn from this that the mere *observation* of the content, intense as it may be, amounts to nothing. It is plain, finally, that this comparison of one content with another may be carried to any desirable extent. Various stages may thus, indeed, be distinguished in the consciousness according as simply the thing itself and its own nature is conceived; or its connection with others; or, finally, its significance and importance to our personal life.

CHAPTER FOURTH.

THE INTUITIONS OF SPACE.

§1. Metaphysics raises the doubt whether the existence of extended space, in which we are contained along with other things, is real; whether, the rather, the extended world is not an intuition within us.

Neglecting this question for the present, we proceed upon the common assumption. But since things cannot become objects of our perception by virtue of their existence simply but always on account of activities which they exert upon us, we are led to the question:— "How do objects cause us to conceive of them in that condition of extension in which they are actually situated without us?"

§2. In the eye nature has carefully arranged an apparatus which causes the light rays from an illuminated point to be again collected in a point upon the retina and the various points in the picture here formed to occupy the same relative positions as the points in the object to which they correspond. This so-called image of the object thus carefully produced is, without doubt, an indispensible requisite to the perception of an object in its true form and position.

But it is a fundamental error to suppose that the simple existence of this picture is alone sufficient to explain our concept of the position of its parts.

This whole picture is essentially nothing but a representation of the external object within the organ of sense, and how we experience or know anything about it is just as much of a question as was the question how we perceive the external object.

§3. If the soul itself were considered a being having extension, the impressions upon the retina might be transferred to the soul with their perfect geometrical regularity. Then one point of the soul would be excited by green, another by red, and a third by yellow, and the three would lie as accurately upon the angles of a triangle as the corresponding excitations on the retina.

But it is readily seen that nothing is really gained. The simple fact that three different points in the soul are excited is simply a triplicity of disconnected facts. No knowledge of this, *i. e.*, of the triplicity or the relative position of the three points is thus produced. For this purpose there must be a unifying activity, to which, therefore, as to every activity, all predicates of extension or magnitude in space are entirely foreign.

§4. The same idea becomes more apparent if we lay aside the useless notion of a soul possessing extension and

consider it as a super-sensuous being, which, in order to be brought into relation with definitions of space must be regarded as an indivisible point. In the passage into this indivisable point the manifold impressions must certainly lose all geometrical relations which may have been retained upon the retina as do the rays of light which converge to the focus of a lense. Beyond the focus the rays diverge in the same order as they came. Nothing analogous to this, however, takes place in our consciousness. The various impressions which existed contemporaneously do not again become distinct, but, instead, excite the activity of conception, which distributes their images upon the space which is only an intuition of its own. Here applies again the remark that the concept is not that which it conceives, and the concept of a left hand point does not lie at the left of a concept of a point at the right, but the conception which itself has no properties of extension, so conceives the points as though one lay to the left, the other to the right.

§5. The following result is before us:—

Many impressions are in the soul at once, but not spatially distinct, but rather like the simultaneous tones of a chord, *i. e.*, qualitatively diverse but not alongside or under one another. Nevertheless, out of these impressions must be produced the concept of relations in space. The question immediately arises, how does it

happen that the soul does not apprehend them as they really are, *i. e.*, unextended, rather than in spatial relations, which they are not. The sufficient ground cannot lie in the impressions themselves, but must be simply in the nature of the soul in which they appear, and upon which they merely operate as stimuli.

On this account it is customary to consider this tendency of the soul to conceive of space as a primitive, inborn capacity. In truth one must be contented with this result. All the attempts to explain why this intuition of space is a necessary attribute of the soul have completely failed hitherto.

There is no occasion for complaint, however, for the simplest elements of the soul's experience must simply be accepted as proved facts. No one, for example, seriously asks why air waves are heard rather than tasted.

§6. Much more important is the second question: Supposing the soul to possess the function of conceiving certain diverse impressions as distributed in space, how is it that each individual impression is so referred to a definite point in the space thus conceived that the result is a faithful representation of the object which affects the eye?

Obviously, the impressions themselves must furnish the clue. The simple qualities of the sensation red or green do not contain it, however, for each such color may, from time to time, appear in every part of space.

and can not, therefore, be referred always to a definite point.

But now we remember that the care with which the accurate position of the various irritants upon the retina is insured cannot be in vain. Certainly it is true that an impression is not perceived at a definite point because it is at that point, but it is certain that it might affect the soul far differently in this position than if it were produced in any other point.

Now we will imagine the following arrangement: Each color-impression **R**, for example red, produces the same sensation of redness whenever it affects the retina. But along with this in each point, **a**, **b**, **c**, etc., a certain accessory impression, **A**, **B**, **C**, etc., is produced which is independent of the nature of the color seen, and simply depends upon the peculiarities of the irritated spot. In this manner a local impression is associated with each color-impression, so that **RA** will indicate a red reaction at the point **a**, **RB** a red reaction at the point **b**. These associated impressions become indices which enable the soul to refer the same sensation red now to one and now to another place, or even simultaneously to various points in the space perceived by it.

In order that this may occur in an orderly manner these accessory impressions must be quite distinct from the principal ones, and not interfere with them. But they must not only be like in kind, but definite members of a series, or a system of series, so that each im-

pression **R** may be able, by its local index, to distinguish, not simply a particular, but an absolutely definite place from all others.

§7. This is the theory of *local indices*. The fundamental idea is that all diversities in extension, and relations between impressions upon the retina must be translated into corresponding unextended but simply intensive relations between the impressions concurring without extension in the soul. These are not reflected in actually discrete impressions, but there results simply a concept of such a redistribution.

Up to this point we hold this principle to be *necessarily valid*. On the other hand, only hypotheses are available to answer the question, in what these impressions consist which are assumed as accessory to the sense of sight. We suggest as follows: If a bright light fall upon the sides of the retina, where, as is well-known, the sensitiveness to impressions is duller than in the middle, there results a rotation of the eye so that the more sensitive part of the retina becomes the receptive organ. This we call casting a glance upon that light. This motion takes place involuntarily, originally without our realizing its purpose, and always without our consciousness of the means by which it is effected.

We may, therefore, include it among the so-called reflex motions which result from the excitement of a

nerve, otherwise sensory in function, to transmit a stimulus resulting in a definite motion; this taking place by means of existing anatomical connections, in a way entirely mechanical, without farther agency of the mind.

Now in order to produce such a rotation of the eye, suited to the purpose mentioned, each individnal part of the retina must, when irritated, produce a degree and direction of this rotation peculiar to it alone. At the same time, however, all these rotations would be quite analogous motions and members of a series graduated according to their magnitude and direction.

§8. The application of this theory (many minor points aside) is as follows:—

If a bright light fall upon a point **P** of a retina which has, as yet, had no sensation of light, there results, by virtue of the connection of nervous processes, such a rotation of the eye that, instead of **P**, the point **E**, where the impressions are most vivid, is submitted to the irritation of the light. During the rotation of the eye through the arc **P E**, the soul is conscious of its position at each instant, a feeling similar to that by which we are informed of the position of our members in the dark. The arc **P E**, therefore, corresponds to a series of constantly changing sensations of position, the first member of which we may also call **P** and the last **E**. Now, when in a second instance the

point **P** is affected by light, the result is not only a repititon of the rotation **P E**, but the very first member, **P**, of the series of sensations of positions reproduces the whole associated series **P E**, and this series of concepts is independent of the actual rotation through the arc **P E**.

The same thing would take place in another point **Q**, except that the arc **Q E**, the series of sensations of position **Q E**, and the introductory member **Q** would have different values.

Finally, if it should happen that both the points **P** and **Q** were irritated to the same degree, and the arcs **P** and **E** and **Q E** were similar, but opposed to each other the actual rotation **P E** and **Q E** could not take place, nevertheless, the irritation of the points **P** and **Q** would not be inoperative. Each would reproduce the series of sensations of position belonging to it, **P E** or **Q E**. Therefore, although the eye does not move, the excitement of the points **P** and **Q** associates with them the concepts of the magnitude and peculiarities of the series of changes which would be experienced by the consciousness in the act of transferring the irritations to the point of the eye where they would be most clearly seen, or, in ordinary parlance, in the act of casting a glance. We now may state that in the act of seeing a thing to the right or left of a given line of view we simply become conscious of the amount of effort necessary tc cause them to coincide with that line.

§9. In this discussion we have simply explained the relative position of the individual colored points in the field of view. This whole image would, however, have no position in any greater space, indeed, no concept of such space would be present. We obtain the image of a place at first through the agency of the eye, the opening and closing of which (of which processes we are otherwise conscious) determine its existence and non-existence.

The visible world is before the eyes, and whatever is behind not only does not exist for us, but we do not yet know that there is such thing as "behind us." Motions of the body extend our knowledge. If the field view in a certain position contains the images **a, b**, and **c**, passing from left to right, and we then revolve upon the axis of the body toward the right, **a** disappears, but on the right **d** is added. We perceive in succession the images of **b c d, c d e, d e f. . . . x y z, y z a, z a b, a b c.** As a result of a recurrence of the original images we have two thoughts: first, that the visible objective world is in the form of a continuous extension all about us, and, secondly, that the alterations in our condition, of which we are apprized during the revolution by the varying sensations of position, depend upon changes in our relations to this quiescent external world, *i. e.*, upon motion on our part. It is easy to see that out of the concept of a continuous horizon the concept of spherical extension may be derived by various revolutions in other directions.

§10. This spherical surface would possess only superficial extension, and no hint of a third dimension would be given. The concept that such a thing as a third dimension of space exists can not spring up spontaneously, but must be derived from experience, which comes of passing about among the visible objects.

From the manifold variations in the various images we reach the impression, in a way tedious to describe, but easy to imagine, that every line in the original image is the beginning of new surfaces, which do not coincide with those first seen, but lie at a greater or less distance from them in space which extends in all directions.

We have later to consider the question how we estimate the distances in this third dimension of space.

§11. The crossing of the rays of light in the small opening of the pupil causes the image of upper points in an object to lie below, and those of lower points above, upon the retina, so that the image, as a whole, is reversed. But it is only prejudice which makes it seem enigmatical that we do not see things upside down on this account. Like every geometrical peculiarity of the image this relative position is utterly lost in the transmission into consciousness, and the position in which a thing is seen is not at all predicated by the position of the image.

But in order that we may ascribe position at all to objects—in order, in other words, that the expressions

above, below, upright and inverted, may have a meaning, it is necessary to have a concept of space which is entirely independent of the sensations of vision—a concept of space in which the entire contents of the field of vision may be arranged, and in which, above and below are two qualitatively opposite, and consequently not confusible directions.

The muscular sense furnishes such a concept. Below is the point towards which gravity tends, above is its opposite. Both these directions are clearly distinguished by immediate sensation, so that we are never deceived as to the position of our body in the dark.

We call objects upright when the lower part of the object is seen by the same motion of the eye by which we see parts of our person which our muscular sense assures us are below, and the upper parts of the object in like manner with the same motions which bring upparts of the body into view.

This agreement is brought about by the inverted position of the image on the retina. In an eye in which the sensitive surfaces were in front of the axis of rotation, but with the greatest sensitiveness in the centre of the retina, the same result would require the image to be positive.

§12. It is not possible to explain satisfactorily why we see singly, although having two eyes. It does not indeed always happen, but two impressions must fall

exactly upon two definite points, in order to combine.

Naturally, we might explain that the two points which correspond must produce identical local indices which can not be distinguished, but we can not demonstrate how this postulate is satisfied. In like manner physiology contents itself with simple names.

Points on the two retinas which produce simple impressions are called *identical* points, and those which furnish double impressions are called *non-identical.*

§13. We naturally refer irritations of the skin at once to those points of the skin where we see them operate, but in case of a repetition when we cannot see them, the memory does not assist in the least, for most of the ordinary irritants have affected all possible parts of the skin, and might be referred to one point as readily as another.

In order to correctly localize them, we must be informed anew at each moment where they belong, that is to say, some accessory impression must be associated with each primary impression (of impact, pressure, heat, or cold) and independent of it, but dependent upon the point irritated.

The skin is able to give rise to such local indices, for, on account of the continuousness of the skin, no single point can be irritated without a displacement, tearing, stretching or vibration of the adjacent parts. Moreover as the skin possesses, at different points, different

thickness, various elasticity or moveableness—passing now over firm surfaces of bone, now over the fleshy muscles, and now over cavities—and, as these relations vary with the varying positions of the members, it follows that the sum of the accessory influences about one irritated point would be different from those grouped about another. These influences when received by the termini of the nerves, and apprehended by consciousness, may cause the indescribable sensation by means of which we distinguish a touch at one point from one at another. It can not be said, however, that every point of the skin has a peculiar local index. The experiments of E. H. Weber show that on the margins of the lips, the end of the tongue, and the ends of the fingers, two points of contact (with dividers) can be distinguished when only one half a line apart, while there are places on the arms, legs, and back which will not distinguish them at a distance less than twenty lines. This is explained as follows:—Where the structure of the skin varies little over large areas, the local indices vary but little from point to point. Where both irritants operate simultaneously, the accessory effects are mutually obscured, so that the points are indistinguishable, while the same irritations produced successively, when that obscuring of the accessory effects is not produced, may be still quite distinguishable. On the other hand, we do not know how to explain any farther the extraordinary sensitiveness of the lips, for example.

§14. The above explanation simply shows how impressions upon different points may be distinguished. It remains to refer each impression to the definite point where it operates. This is easy for those who see, who already have a perfect image of the surface of the body, and after once seeing an irritation produced at any point are able to mentally locate the sensation, even in the darkness, by means of the identity of the local indices.

One who is born blind, however, must construct this image by means of the sense of touch. This, of course, is accomplished by means of motions of the tactile members, and the formation of an estimate of the distance passed through in connecting one point with another. It must be remembered that these motions are not seen, but are appreciated only by the sense of muscular exertion, *i. e.*, by means of sensations, which, as it seems to us, are simple qualitatively diverse, and and do not in the least indicate the motions which are their real causes. How this muscular sense of the blind acts as an index of position we cannot say, but, in all probability, the reason lies in the fact that the sense of touch, like the organ of vision, may receive several impressions at once, and that during a motion all previous impressions do not disappear at once, leaving no trace, but each adjacent set of impressions have a common factor, as represented above by the combinations **a, b, c**; **b, c, d**, etc. In this way it appears that the idea is

reached that the circumstance which produces for us the alteration in muscular sense consists in a change in our relation to a series of objects which occur in a definite order, that is in a motion.

§15. It may be doubted whether the concept of space which the sense of touch affords a person born blind, is at all similar to that of one who sees. It would, the rather, be assumed that there would be far less distinct concepts of the time, degree and effort in motions used in connecting various points as compared with the clear, easy and comprehensive apprehension of those who see. (Compare upon this point the evidence of blind persons who have sustained operations:—Cheselden in Philos. Transact., 1728, vol. 35; Helmholtz, Physiologische Optik.)

CHAPTER FIFTH.

SENSUOUS PERCEPTION AND ILLUSIONS.

§1. A simple sense-impression represents only the impression and does not reveal the *thing* to which it belongs as its peculiarity, condition or effect. This further interpretation is the province of the *understanding*. It is the understanding that is at fault if, after having once found the concept **a** connected by the incompletely apprehended accessory conditions **c**, with the second concept **b**, we are led to conceive that **a**, when repeated under other conditions, **d**, must be connected with the same concept **b**.

But the senses themselves are not always so innocent as in this case.

The eye, for example, as it represents the outer world with its three dimensions upon a plane, gives false relations between the images of individual objects. Here, therefore, where the sense falsifies and the understanding must rectify, we may correctly speak of illusions of sense.

Here may be classed the diminution in the size of distant objects; the convergence of parallels in the distance; the elevation of the surface of the sea above its shore—simply appearances which persist as sensuous

apprehensions even after the understanding is convinced of the real relations.

§2. We estimate the same portion of space larger if it be bright colored, but smaller if dark; the filled bottle appears to the eye larger than when empty; a rough object seems larger than a smooth one to the sense of touch. An object appears longer in the direction indicated by the course of numerous lines upon it than it really is. All these effects are utilized in the decorative arts. We estimate distance very indefinitely, that of a bright object less, of a dark one more; that of an object, the markings of which remain clear, much less than when causing a confused impression. Generally, we use three elements, the real size, the apparent size and the distance to find one by means of the other two. If the real size is given (for example, because we know the object to be a man or child), and at the same time the apparent size, then we estimate the distance as so much the greater the smaller the second is as compared with the first. If we know the apparent size and the distance, we may estimate the real size in the same way. If, finally, we know the real size and the distance, we can find the apparent size in which, for example, the object must be drawn in order to appear at the given distance.

If, however, the objects, for example mountains and water surfaces, leave no natural scale, so that only the

apparent size is given, we can only arrive at the real size and distance by dividing it into parts which we estimate according to their relations to the apparent size of a known object contained in them. A very important means, finally, is furnished by parallax, *i. e.*, the amount of displacement of the image of the object **C**, upon a fixed background, **P**, **Q**, **R**, if viewed from both ends, **A** and **B** of a line, **A B**. This is greater for a nearer and less for a more distant object. We use this method daily by fixing an object in one eye and then the other, or moving the head from left to right, or walking intentionally to and fro.

Science has made great use of this by carefully performing the same experiment with the assistance of fine instruments for measurement.

§3. The comparison of sensuous qualities (colors, sounds, tastes, degrees of warmth) affords a certain quantitative measure of the impression, be it intensity or extension in space or duration of time. It demands, moreover, that the testing organ be exactly the same in order that the various local indices shall not modify the impressions of different organs. A person does not test the warmth of two vessels of water simultaneously with two fingers, but successively with the same, etc. At the same time the other breakers must be avoided—that of allowing too great a time to intervene to leave both impressions vivid in consciousness, or too short a time,

so that the secondary effects of the first interfere with the second impression. These secondary effects are of two sorts. If they are strong and fresh, they obscure the second impression, but very often, and in the cases of different senses, it happens that the nerve which has been for a long time subject to the same excitement, after this has ceased, spontaneously assumes another sort of excitement, through which it passes again to its state of equilibrium. And this counter excitement produces sensations, as, for example, an eye long effected by green, red, or yellow sees afterwards the complimentary colors—red, green, and violet. These contrasting sensations appear in the case of ordinary and muscular sensation as well.

§ 1. We consider a body to be in motion if its image moves over the retina, and this appearance not only takes place if we experience a passive motion (as in riding on shipboard) but, also, when we are conscious of our motion and convinced that the objects which we are passing are stationary. Naturally, the apparent motion of objects is the opposite of our own motion.

The well-known revolving motion which occurs after spinning about for some time and suddenly becoming stationary appears to be caused by an unconscious movement of the eyes in the direction previously pursued by the body. This motion, when it reaches the corner of the eyes, is instantly reversed but to begin over again,

thus the same objects pass by continually without intermission.

§5. If any object, as, for example, a staff, is brought into loose contact with the body, say the hand, in such a way that change of position is possible, a new and peculiar combination of sensations of pressure on the different fingers, for example, is produced. Out of each combination we form, from earlier experience, a concept of the position which the object (as the staff) then occupies.

If now the staff be brought in contact with an external object, and if it meets the same resistance in all its positions and this pressure acts through the staff upon the hand, we not only transfer the position of this resistance to the common intersecting point of all these positions, but we think we feel it immediately and clearly at the place where it is offered, just as if the staff were endowed with sensation as much as the surface of the hand on which its other end rests.

This feeling of *double contact*, which has innumerable examples, produces a peculiar vividness in our conceptions of external objects. It serves, first of all, to make possible the profitable use of many tools, as, for example, the probe, knife, fork, pen, etc. By means of it we seem to perceive the resistences or obstacles to these instruments *in loco*, and are able to apply the proper corrective instantaneously.

It teaches us, furthermore, of many of the peculiarities of things, for example, of the length of a balanced stick, or the breadth of a ladder rung, or the length of a thread attached to which a ball revolves about the hand.

Finally, it gives us the pleasant feeling of an existence in spirit beyond the limits of our bodies, and this is the reason for the numerous delicate and peculiar prolongations or appendages of our body which usually serve as ornaments.

[*Note.*—The further elaboration of this thought belongs to *Physiology*, but the force of the remark would be lost if considered to apply simply to the hair and nails, upon which we are much more dependent for our sensations of the outer world than we at first realize. The minute ridges and points found upon the skin of the hands serve in the same way that a probe does to acquaint us with the position of an object, for example, a needle, which otherwise we could only use as roughly as we now do when the fingers are gloved.—C. L. H.]

CHAPTER SIXTH.

THE FEELINGS. [SUSCEPTIBILITIES.]

§1. We apply the term feelings exclusively to conditions of pleasure or displeasure as contradistinguished from sensations, these being but indifferent perceptions of a content.

We do not thereby assert that these two spiritual activities appear separately, it being more probable that primarily no concept is entirely indifferent, but, rather that the feelings of pleasure or displeasure inhering in them only escape our attention because, in adult life, the sense and significance which the impressions have for our sphere of existence have become more important to us than the consideration of the impression itself.

We conclude, therefore, that, as notions, sensation and feeling, although always connected, are quite distinct efforts, and not derivable the one from the other.

Not any sort of a relation between various simultaneous sensations or conditions produces of itself, an effect upon the sensibilities, but it is necessary, in order to produce a feeling that this relation should be brought to bear upon the soul, producing a reactionary activity of a faculty not previously included, *i. e.*, a feeling.

§2. A natural though undemonstrable inference, and a reasonable hypothesis is that feelings result from, and, at the same time, indicate the agreement or disagreement between the excitements produced within us and the conditions of the continuance of our well-being. Pleasure would then be the result of the stimulation of our natural faculties within the limits of these conditions, and would increase with the intensity of the excitement; pain, on the other hand, would be induced by the fact that the excitement produced, partly on account of its intensity, and partly on account of its form (which is generally overlooked), disagrees with these conditions. This does not imply that the soul first observes the excitement, then its relation to these conditions, and, finally, decides, according to the opinion produced by these acts, to feel pleasure or pain, but, it is like sensation, say of a red color, simply the result of a series of processes in the nerves (although it does not enumerate them). In like manner, the feeling is only the last result of that strife or disagreement and only enters consciousness at the close of this unperceived process.

§3. Pleasure and displeasure are general terms, which, thus comprehensively taken, do not designate a concrete thing, but every real pleasure or displeasure has its own specific character, and these cannot be formed out of various portions of a general pleasure or

pain any more than the various colors are produced by different combinations of light and shade. Of the conditions under which the feelings in general, or definite forms of feelings arise, we know almost nothing.

The first group which we can distinguish, the *sensuous feelings*, *i. e.*, those which depend directly on sense irritations, are the more intense in the various senses the less these senses are adapted to discern them objectively.

Colors and their contrasts produce simply satisfaction or dissatisfaction: dissonances of sounds disturb the hearer, personally; pleasure and displeasure of taste and smell are much more intense; but only in the skin, which itself furnishes but little information, and in the inner portions, which do not contribute at all to our knowledge does this displeasure assume the character of actual pain. The advantage of this arrangement is evident, but the mechanical cause is unknown.

§4. These less intense feelings of the higher senses lead to a second class, the *æsthetic feelings*, which are connected chiefly, but not exclusively, with the simultaneous occurrence of numerous impressions and, in the simplest cases, are actually dependent upon the simplicity or complexity in the relations which subsist between them.

The real reason why this simplicity, for example, in concordant sounds, acts favorably upon us is unknown.

for these relations, as such, are not, as a rule, perceived.

The character of this æsthetic feeling of satisfaction or dissatisfaction can be distinguished from simple sensuous comfort and discomfort in that the universal spirit within us and not our personal well-being is augmented or disturbed by these impressions. To these are added the *ethical feelings*, of which we must speak because approbation or disapprobation is simply the expression of an importance or lack of it which we perceive only in our feelings, and on this account is quite distinct from a merely theoretical judgment concerning the truth or falsity of a postulate.

§5. Further description of the susceptibilities is unnecessary, but, on the other hand, it is useful to distinguish two conditions.

That is frequently called feeling which should really be called *affection*, consisting, not in a quiet condition or mood of the soul, but in a motion which—as in anger or fear—produces disturbances in the process of conception, and also generally includes involuntary motions, partly simply gestures, and partly the beginning of actions which arise from the given inducing cause if not controlled.

In like manner we must distinguish *sentiments*, *i. e.*, those apprehensions by the soul that certain contents of conception have always a definite value. Bravery or patriotism are not themselves simple feelings but causes

out of which, according to the nature of circumstances, varying sorts of feelings may spring.

§6. The notion "I" is usually defined as that of the simultaneous subject and object of consciousness. This definition, right as it is in itself, applies, nevertheless, to every being which participates in this general character of identity. When we speak of *self-consciousness* we do not mean the general form of activity which "thou" and "he" possess equally with "I," but we mean that knowledge by which we distinguish "I" from "thou" and "he." It would be useless to affirm that "I" is the subject and object of *my* knowledge, but "he" subject and object of *his*, as long as we are not fully clear as to the distinction between that which is mine and and that which is not mine, or his.

This distinction cannot be taught by any simply theoretical consideration in which "I" and "thou" would be simply indifferent examples of such a subject-object.

The reason that we are able to call one of them "I" and contrast it with the whole of the remainder of the world by distinctions of an entirely different sort and value from those between a second and third thing is that our own conditions are not simply objects of conception, but at the same time awaken an immediate interest, pleasure or displeasure, which the same conditions pertaining to any subject in general, but not suffered by us, would by no means produce.

In this immediate way we learn at first to distinguish between what is *mine* and *not mine*. The concept of "I" is later, and signifies that subject-object which is the central point in the "*mine*" thus discovered.

Two elements are to be distinguished. The image which we form of our own existence may be more or less faulty or erroneous, that depending upon the amount of that power of reflection by means of which everyone strives to explain, theoretically, his position with relation to this central point. The evidentness and vividness with which every susceptible being distinguishes itself from the whole world does not at all depend upon the perfection of this fine insight into its own existence, but expresses itself in the lowest animal, in so far as it recognizes its own condition by pleasure or pain as its own, quite as vividly as the most intelligent spirit.

A spirit, however, which viewed everything without participating, by pleasure or pain, would neither be capable nor, if capable, would it be influenced to set itself up as "I" against the remainder of the world; he would himself be one of, but not at all taking precedence of, the many examples of a being at once subject and object of thought.

CHAPTER SEVENTH.

MOTION.

§1. Our motions take place independently of a knowledge of the means—muscles and their contractility—and certainly without our knowing how to proceed to cause the proper excitement in a given motor nerve to produce a definite motion in the necessary muscles. It follows that in no case does the soul produce the motion by its own direct action, and by going itself into the details, it always produces, however, a certain inner condition in itself (of wish, will or desire). This condition is connected, by a natural law quite unapproachable by consciousness and independent of the will, with the production of a motion as its result.

It is, therefore, only necessary to learn the various conditions of the soul which in this way become the occasion of bodily movements.

§2. In the living body ceaseless changes are going on which affect the motor nerves and produce motions, in the production of which the soul does not participate. They are, nevertheless, important, for it is only by seeing that motions occur spontaneously that the soul of an animal can reach the thought that its body is

movable, and that its motions are connected with its own inner conditions—an idea it could never attain if it lived in a body never set in motion either by itself or some external cause.

§3. The reflex motions may be distinguished as a special class. Such motions take place when an excitement of a sensitive nerve produced by an external or internal irritation is so transferred without the aid of the mind in the central organ, to motory nerves that, at a stroke, the group of muscles necessary to the appropriate motion is excited to motion. A conscious sensation may accompany this act, or the excitement may produce the motion and avoid appearing in consciousness.

Many of these motions, such as coughing and sneezing, the movements of the pupil of the eye when affected by light, are reactions arranged for by nature in the structure of the body as protection against injury. That they are certainly mechanical results of the excitements is proven by the fact that they take place involuntarily, neither can they be prevented by the will but only by artificial hindrances.

§4. In the mimic and physiognomic motions—laughing, crying, sobbing and the like—the point of departure is, in the first instance, a psychical condition, namely, of the feelings, and they are all very difficult to

artificially imitate, and then only when one purposely projects himself by fancy into the same state of the feelings which is their real cause.

All these motions, however, take place without knowledge either of their origin or use, for one can not explain why he must laugh in joy and cry in pain, rather than the reverse.

They are, therefore, motions which are connected by a natural law, which is neither invented nor well understood by us, with states of our feelings, as being their actual results.

§5. A fourth class is formed by the *imitative motions*, as, for example, those made when the observer unconsciously imitates the blows of the boxers or of those playing at ten pins, and when the uneducated narrator imitates the motions described. In this case it is the conception—and that of a definite motion—which, without further knowledge or volition, is translated spontaneously into the motion. To this class belong most of our daily motions which we often even call acts. As soon as, at the conclusion of a train of thought, the conception of a motion founded upon it springs up and no resistance is offered it in any quarter, this concept passes over spontaneously into a motion without a distinct impulse of the will needing to be exerted or perceived.

This applies particularly to acquired accomplishments, as of writing or piano-playing, where the simple con-

ception of the production of a sound produces the necessary movements without any distinct conception of these motions being developed in consciousness.

§6 These considerations appear to constitute a distinction between *voluntary* and *involuntary* actions. In fact, they do not. Let our convictions of the nature of the will, to be developed later, be what it may, nothing can be ascribed to it but *willing*. It can only produce a result when a given change in the condition of a motor nerve is combined with a given decision of the will, as the spiritual conditioning agent, by a natural law independent of it. When this is not the case the will remains a useless wish without result.

An act is voluntary if the internal initiatory conditions from which an act springs are approved, adopted, or controlled by the will when they have taken place. Involuntary is every one which, although it, mechanically considered, springs from the same initiatory point and proceeds in the same way, does not experience such approval.

The control of the will may be likened to our use of the Alphabet. We can not devise new sounds or letters but are limited to those which the organs of speech makes possible, but we can combine these in endless variety. In like manner, the soul, in that it combines the initiatory conditions as it pleases, may unite these elements of corporeal origin—motions—into the most varied processes and thus affect the expression of its will.

PART SECOND.

THE SOUL.

(THEORETICAL PSYCHOLOGY.)

CHAPTER FIRST.

ON THE EXISTENCE OF THE SOUL.

§1. After this enumeration of the individual elements of the inner life we inquire concerning the nature of the subject in which they inhere or are made possible.

Our final conclusion will be most simply developed by using those provisional views which we are accustomed to at first employ, and then gradually transforming them in order to adapt them to encounter difficulties with which, in their earlier form, they could not cope. It must be remembered that everything can not be said at once, and that only the final form which our view assumes is our ultimate conviction.

§2. The permanent union of the spiritual life with the bodily, in which alone it becomes the object of observation, makes the attempt natural to regard it as simply a product of bodily functions.

However, it is an old discovery, recently newly made, and by no means wanting in truth, that out of all combinations of material conditions the origin of a spiritual condition of the soul never becomes analytically conceivable; or, more simply expressed, if we think of material elements in such a way as to predic-

ate of them nothing which does not belong to the notion of matter, if we simply conceive of them as entities in space which are moveable and may call each other into motion by their power; if we, finally, imagine these motions of one or many elements as varied or combined as we please, there never comes a time when it is self-evident that the motions last produced may not longer remain motions but must be transformed into sensations. A materialism, therefore, which assumed that a spiritual life could spring out of simply physical conditions or motions of bodily atoms would be an empty assumption, and, in this form, has hardly ever been advocated in earnest.

The materialistic views which have really had adherents have proceeded from the premise that what we call matter is really better than it externally appears. It contains in itself the fundamental peculiarity out of which the spiritual conditions may develope just as well as physical predicates—extension, impenetrability, etc. —are developed out of another fundamental peculiarity. From this results the new attempt, out of the reciprocal operations of these psychical elementary forces to elucidate all the elements of the spiritual life just as its bodily life is derived from the reciprocation of the physical elementary forces of its constituents.

§3. This view, though not, on its face, improbable, is wrecked upon the fact that it is impossible to explain

by it the origin of that unity in consciousness which is a fact of experience, and which we are not justified in ignoring, simply because it is enigmatical, in order to explain more easily the balance of experience.

If it be said that, just as from two different motions a simple resultant is produced so that the plurality of the causes producing it is no more seen, so, from a unification of the plurality of psychical motions a complete unity of consciousness is formed, this would be an inaccurate expression of the analogy drawn from mechanics.

It is, indeed, true that if two motions act upon one and the same indivisible point or physical element, they produce a simple resultant. This resultant does not hang in the air, however, but exists only as a condition of the simple element upon which the components operated. Thus completed, this analogy does not lead to the result expected, but back to the ordinary view, namely, that these numerous elements, even if they possessed psychical capacities, could only produce the unity of consciousness if there existed a single indivisible element upon which all their activities operate, and which must be so constituted as to concentrate all these impressions in its consciousness.

§4. If we denote by **a, b,. . . . z** the single bodily elements which are assumed to be both physical and psychical, the question arises, what result would be produced in a given time by the reciprocal action of one upon an-

other? If they were all similar and under like conditions it would hardly fail to happen that at the end of the time all would be in a similar state, **Z**. If this state **Z** then were a consciousness it would be present in our consciousness with the same content, as many times expressed as the number of elements acting upon one another. On the other hand a unity of the consciousness, aside from this similarity of all the individual consciousnesses, would not result.

In reality, the elements **a**, **b**, ... **z** are not similar, but they certainly stand under various conditions in the structure of the organism, some of them, on account of their restricted nature and unfavorable position, can apprehend vividly but few operations from without, others, superior and better situated, develope a much richer consciousness of all the possible conditions of the others represented in it. Which, now, out of the many dissimilar examples of consciousness is *ours* —that which we know by inner experience? We naturally would assume that it would be the consciousness of the most highly developed element of all—the central monad of our body, according to Leibniz. For we find the alterations in our body most closely connected with the condition of the "I," and very little goes on in it which we have reason to ascribe to the activity of other central points of consciousness.

§5. It follows that we do not succeed in evading the

view of the single and indivisible *subject* [soul] of our consciousness as a distinct part, while the other parts constitute a *body*, *i. e.*, an aggregate of many elements which, taken separately, may be related in nature to the soul, but in no instance are identical with it, but are dissimilar beings.

This assumption, in itself conceivable, of a soul life in every bodily element remains quite useless for the explanation of *our* soul life, for we can not transfer ourselves into the condition of these elements. They have worth for us simply as they operate as irritants upon our soul and thus produce that internal condition which is alone known to us. Therefore we may consider material elements as matter simply.

The other related assumption, that the soul, on the other hand, possesses physical peculiarities, perhaps promises to be useful, but the popular consensus has not received it, but, rather, has contrasted the soul, as an immaterial being, to material elements and thus produced the difficulties of the following chapter.

CHAPTER SECOND.

THE RECIPROCAL ACTION BETWEEN SOUL AND BODY.

§1. Let the possibility of an immaterial existence be admitted (of which more anon)—it is then customary to object that, in that case, no reciprocation, at least, between it and the body is possible. The latter would find on the shadowy soul no point of application for its physical forces: the soul would produce no effect upon matter by its inner conditions, thus the complete dissimilarity of the two would prevent all action.

§2. To this it may be replied, that we deceive ourselves if we believe, in any case whatever, that we apprehend the condition of a reciprocation, and if we consider that relation between soul and body in which this does not occur as an exceptional state of inadaptability.

If we observe the inner mechanism of a machine and the connection of its parts, we think we understand its operation because our observation has been able to notice various things about it. Upon a little reflection, however, we find that we do not understand either of the two conditions upon which rests the operation of

the machinery, *i. e.*, the cohesion of its parts and the transference of the motion.

Many words may, indeed, be expended upon it, but we do not yet know how one element of a solid body sets about it to hold fast its neighbor, or how it is able to cause the motion with which it is affected to cease and to reappear in another part. What we really observe in these cases is but the external imagery in which a series of processes passes by, each individual of which is united with its successor in a completely invisible and incomprehensible manner.

In the relations between soul and body we cannot follow this series of processes as far as we wish, but if we were able to follow it, for example, to the point where the physical excitement acts upon the soul, this latter transition would, indeed, be quite unintelligible, but no whit less comprehensible than the transference of a motion from one material element to another.

§3. The source of the doubt above-mentioned is the false assumption, common even in antiquity, that only similars can operate one upon another, or be affected by each other.

One can be tempted to make this assumption only by considering the activity to be produced simply as a condition which is already present in the operating cause **a**, and may be transferred to **b** without alteration, and, consequently, presupposes a similar lodgment in **b**

as in **a**, and thus a complete parallelism between **a** and **b**.

On the other hand, we borrow from metaphysics the conviction that such a severing of the condition from that of which it is a condition and its transference to another subject is completely inconceivable. The effect of an **a** upon a **b** consists always in the fact that a condition, **A**, of **a** is the occasion which produces, according to an universal law, of which nothing is to be said here, in **b**, out of its own nature, the condition **B**, which, in general, need have no similarity to the condition **A**. Even ordinary experience teaches that one and the same effect, **A**, may produce the most various results, according as the objects, **b**, **c**, and **d**, upon which it acts, differ.

We have, therefore, no right to set up conditions which must be fulfilled in order that **a** may affect **b**. The identity, or similarity of both gives the possibility of their operation no greater comprehensibility or plausibility than would their dissimilarity or even their incomparability.

§4. A bond between body and soul is often demanded in order to make comprehensible the possibility of their reciprocation. However, bonds are only needed to unite those things which, of themselves, will not act upon each other, but are quite indifferent to each other.

The uniting power of a bond consists in the fact that

its elements are united with each other: nevertheless, we can not be always supposing new connecting links, but come, finally, to an immediate reciprocal action of the individual elements which cling together without the intervention of any sort of machinery.

A bond between body and soul would, then, only be needed if they were quite indifferent the one to the other. If we had such a bond it would not help us, for the specific form in which the body would act upon the soul and the soul upon the body by means of it would depend not upon the bond, but upon the specific nature of the two connected elements and their obligation to reciprocation.

Instead of one such bond then, we assume that both are connected by many peculiarly formed bonds. Each individual reciprocal action to which they are compelled by their own nature, is such a bond, which connects, not in a general, but in a definite way.

§5. We proceeded upon the agreement that the notion of the soul as an immaterial being is possible. Now, however, even this is denied. Only sensuous things, it is said, are authenticated by immediate observation, super-sensuous are products of phantasy. However, only the most primitive view of nature considers that we apprehend the existence of the objects themselves in their sensuous peculiarities of color, taste, hardness, etc.

We have been long convinced that all these predicates are but appearances which originate in our consciousness by excitation from without. What really is, they do not explain. Actual sensuous perception of material elements was early disclaimed by science. But it has for a long time, in its notion of the atom, conceived of formal elements, similar to the sensuously perceived bodies, which are supposed to be formed by their combination, that is, very small bodies, having, however, a given extension—of unknown, but still definite form—and this small volume endowed with perfect impenetrability.

Manifold difficulties complicating this notion have led to the attempt in physics to regard the atom as completely unextended, or as a point which is distinguished from an abstract point in space simply in that it is the focus of forces which operate outwardly, as well as the point of application for forces coming from without.

Such a conception as this simply means that the atom, in itself, is nothing other than a super-sensuous entity, *i. e.*, not only, on account of its minuteness, unattainable by *our* sense, but, by its nature, unattainable by *any* sensuous apprehension, and that the sensuous apprehensions which, at first, seem to represent the *real* are simply secondary appearances which the results of the reflex activities of elements, in themselves entirely super-sensuous, are made known to us.

Hence the notion, not of the immaterial, but of the material requires to be demonstrated, and the gulf which seemed to separate body and soul as two completely heterogenous elements and thus to prevent their reciprocal action really does not exist.

[*Note*.—The reader will be interested to compare the ideas briefly set forth in this section with the dicta of modern materialism. (Compare the opening pages of Hermann Ulrici's *Leib und Seele*). Some of the various phases of materialistic thought on the relations of soul and body will be gathered from the following sentences:—

"Will is the necessary expression of a condition of the brain occasioned by external influences" (Moleschott).

"Man is but the sum of parents and nurse, of place and time, of air and weather, of light and sound, and of food and clothing;" or, according to Feuerbach, "Der Mensch nur ist was er isst," *i. e.*, Man is but what he eats.

The final ultimatum—"Thought is as much a secretion of the brain as bile is of the liver or urine of the kidney" (C. Vogt) stands in bold contrast to the teaching of our author here and elsewhere.—C. L. H.]

CHAPTER THIRD.

THE SEAT OF THE SOUL.

§1. An immaterial being can have no extension but may have place, and we define this as the point to which all effects from without must be transferred in order to produce an impression upon this being, and from which alone this being exerts its immediate activities upon the environment.

In regard to the soul, no one questions that it is only present within its own body and here only acts immediately upon its environment by the agency of the body.

§2. It has been attempted to conceive of the soul's special relation to the body according to the analogy of our conception of the omnipresence of God. We understand by this that God is as near with immediate efficiency to one point of the world as to every other, that his will neither requires to pass over any distance to reach the world element z nor needs any intermediary means to apply it to z. But we do not, by any means, understand that the unlimited extent of the arena which God thus rules applies to himself as a personal peculiarity.

In like manner, it is conceived, the soul, without

extension in space itself, is, in its own body, all-present. This analogy is, however, quite unserviceable. We have already seen in the discussion of feelings of double contact how nature succeeds in producing the illusion, so indispensable to the beatification of our life, that we are present with immediate sensation and motion in every part of our body.

On the other hand, physiological experiments show that the soul stands only in immediate reciprocation with the central organ of the nervous system, with the entire remainder of the body, however, only mediately, through the nerves themselves.

§3. We are accustomed to assume of a physical force that it operates in infinite distances without intermediate mechanism. It operates, however, in diminishing ratio, in that the intensity of its activity diminishes with the distance.

According to the first condition, we may say of that body which is the conveyer of the force, it is universally distributed in space; according to the second, however, we must confine it to a limited space, that is, where the activity is greatest. This analogy is also quite inapplicable. The slightest discontinuity in a nerve, even in closest proximity to the brain, destroys the reciprocation with the soul throughout the entire region supplied by it. It has, therefore, no force operative at a distance which can overleap this separation.

The third analogy alone remains, *i. e.*, that of operations which take place in contact through transmission of motions.

§4. This analogy has been chiefly followed, and it has been attempted to find such a point in the central organ in which all sensitive nerves unite in order to deliver up their messages, and from which all motor nerves spring in order to distribute the excitements received to the body. This conception not only has certain internal difficulties, but it, in general, does not agree with our empirical knowledge. Not only has such a central point of the entire nervous organism not been found thus far, but we have well-founded reason to assert that it never will be.*

The question now arises how, under these circumstances, the notion of a seat of the soul can be held?

§5. We return to our original definition, but extend it as follows:—We err when we assert that because a thing is in a given place it can act upon that environment. As long as we neglect the activity it is impossible to say what is meant by a thing's being in a place nor how it differs from its existence in another place where it would be exactly as well situated as in this one.

We think the order of thought ought to be reversed,

*See Part Third—Functions of the optic thalmus and corpora striata.

and should say if it is in the nature of a being, **a**, to reciprocate activities with **b**, **c**, **d**, then, by this fact, its systematic position is determined, and, in the arrangement of the world in space, it is that point of which the immediate surroundings are formed by **b**, **c**, and **d**,

But the connection of all things may, in general, be so many-sided that an element, **a**, is not only determined to reciprocate with the group **b**, **c**, **d**, but equally immediately with **p**, **q**, **r**, while **p**, **q**, and **r**, on account of other relations in which they stand, cause its systematic position, and hence its position in space, not to be near them, but separated from them by an interval. In this case the active element **a** would not have *one*, but, with the same degree of truth, *several* positions in space without being sub-divided into a plurality, just as we conceived of God as omnipresent, but not himself extended.

Omnipresence, of course, includes *all* space, here, however, we must assert that the immaterial being must have several distinct seats which are separated by intermediate spaces in which their presence does not in the same sense reside.

Nevertheless, no real difficulty inheres in this view. We have simply to rise above the power of ordinary training which leads us to conceive of the immaterial being according to the analogy of bodily atoms, and, therefore, ascribe to it a sensible, limited magnitude and form, and hence but a single position in space.

§6. The question remains why certain portions of the brain have the preference as seat of the soul over others, although, so far as we know, there are no remarkable differences in the structure or arrangement. Here also we must alter the ordinary conception. A single element, **a**, is not designed to always stand reciprocated with one kind of element, **b**, but not with another, **c**. Every being, **a**, is affected or excited to activity solely by *what takes place* in other beings. Let this activity be denoted by **x**, which, according to universal natural law, is the operative premise from which it is designed that a new condition shall be produced in **a**, then it *is* produced, and **a** receives this influence, whether it is originated in **b** or **c**. On the other hand, if **x** is not such a premise, **a** remains indifferent and unchanged whether **x** occurs in **b** or **c**. In exactly the same way the soul will enter into reciprocity only with those points in the central organ in which all the combinations, adjustments and rearrangements of physical excitations are carried on after the completion of which alone these can rise up into consciousness of the soul, or which are, in other words, the legitimate stimuli of its activities.

§7. If one were able, therefore, to observe microscopically as accurately what goes on within the brain as we may observe the anatomical structure, it would appear superficially just as assumed by materialism; *i. e.*, in various

points of the brain individual psychical processes would proceed at the instigation of physical processes there taking place, and the unit being of the soul would never appear as the object of such observation. However, we do not accept the interpretation given by materialism for these facts.

These psychical functions do not take place as self-evident appendages or products of the physical processes, they can only be conceived as possible if the latter act simply as excitements operating upon the peculiar nature of that soul-being which is omnipresent within these limits and not confined to a point, and thus leading to the exercise of its own peculiar faculties.

CHAPTER FOURTH.

THE RELATION OF THE SOUL TO TIME.

§1. Experience could only lead us to the conclusion that the soul originates and dies with the body. Necessities, foreign to these theoretical investigations, have excited the desire to establish its *immortality*, and this has been attempted by including it under the notion of a *substance* which contains, even in its own nature, the quality of indestructibility.

This subordination leads to two undesirable results which would gladly be avoided, namely, the reasons by which the human soul may be included under the notion of substance would apply equally to every animal soul. On the other hand, this indestructibility pre-supposes not only immortality after death, but endless existence before birth, and thus we do not know where to begin; nor does experience give us any evidence of such previous existence.

Finally, it would be asked, if the notion of substance contains such an unavoidable difficulty, is it, after all useful, and not rather a simple figment of the brain, and whether, in the former case, the soul would belong to that class which should be included in it.

§2. In fact, substance is but a name for everything which is able to act upon others, to be acted upon, or to sustain various conditions and, in these changes, remains the same as a permanent unit.

On the other hand, it is a figment of the brain to believe that further explanation can be adduced as to how the faculty for such conduct is originated, and to seek this explanation by conceiving of a bit of rigid and indistructible substance in each thing, around which nucleus the other peculiarities or conditions, by the which one such thing differs from another, are grouped. Such a notion, when applied, shows itself ever completely unfruitful in explaining those appearances for which it was assumed.

It does not appear how such a substantial nucleus can be consistent with the plurality and changeability of the peculiarities which we are accustomed to assume (by the use of a word without significance) "inhere" in it. Briefly, then, things are not things because a substance is concealed in them, but, since they are as they are, and conduct themselves as they do, they produce in our phantasy the false appearance of such a substance as the cause of their conduct.

The soul, then, inasmuch as it, as unit-subject of its inner conditions, conceives not only of others but is conscious of itself, deserves, in the highest degree, the title of a substance or being.

But this, on the other hand, does not at all justify

the assertion that this capacity, if once exercised, must then always be exercised, and cannot, in the career of the thing, be originated or cease to be.

§3. For the decision of this matter we borrow from metaphysics a demonstration which stands opposed to the conception to which the study of nature has accustomed us. For the latter attempts to explain the course of nature by assuming a multiplicity of original elements, of which each might exist if the others did not, and which, further, have, in themselves, no necessary connection one with another, but are either brought into such relation or else had somehow been placed there, and which, finally, are obliged by general laws to exert one reciprocal action in one relation and another in another relation.

On the other hand, we briefly assert that really no effect of one element upon another is conceivable without contradiction as long as they conceived of as originally independent and unrelated one to another. It is only possible if we consider them as dependent modifications of a single actual being which is in them all as the ground of their existence and, further, the reason why they are obliged, under definite conditions, to act in a definite manner, and, finally, as that which makes the fulfilment of the above-described obligations possible; or, otherwise expressed, all things are not what they are, neither do they act as they do because of an endowment

of their nature which belonged to them before the world was. Neither was the world, at a later period, obliged to conform to them, so that there was only produced, in consequence, what was permitted by these postulates. But they all exist, and operate as commissioned by this single absolute being; and all that we generally consider as the final unalterable elements and laws of nature have this invariableness and value only in conformity to the plan for the fulfilment of which they were ordained.

This view was not invented to satisfy the present requirements, it is, rather, necessary in order to comprehend the simplest effect of one element upon another, but it *is* applicable to our case.

It may lie within the bounds of possibility that all these varying appearances are produced by combinations of unchangeable elements at the dictation of universal laws. For this reason, then, there are in the world those constant quantities whose activities always occur in the same way and which are but the actions constantly produced or sustained by each individual existence. But it also lies within possibility that there are other elements, only appearing in given points of time in the course of nature, namely, when all the conditions are met which, according to the universal plan, can bring them into being.

There is no reason why these elements, when once produced should not conduct themselves as simple,

indevisible and independent foci of converging and diverging activities.

Among these elements we number the soul. A further question—how these are brought into that condition of independence—we dismiss as out of place. Nor can we explain how it is, or was brought about, that those constant elements exist and continue eternally.

§5. At the place and moment in which, in the course of physical nature, the embryo of an organic being is formed, the soul belonging to the organism is formed out of that universal being everywhere present, and this act is a consequent of that physical process. Superficially viewed, materialism seems to be correct in stating that the soul originates in and with (not, however, out of and through) the body. And it is useless to question regarding the manner in which it appears, as it were, from without simultaneously with the body.

So far as immortality is concerned, it is not a subject to be decided upon from a theoretical standpoint. We hold, as of general applicability, only the fundamental law that whatever has once been formed will endure as long as it has an unaltered value for the coherence of the world, but will self-evidently cease to exist as soon as this is not the case. Yet this law is not applicable in *our* hands, we cannot presume to say what may constitute the merit which produces the permanence, or the lack which makes it impossible.

CHAPTER FIFTH.

THE SOUL'S ESSENCE.

§1. In investigating the essence of a thing we may first inquire how this thing differs from another; second, how it is that the content thus indicated can exist as a real thing.

The second question may be answered in the case of objects whose distinctive peculiarities consist only in the form of a material previously existing. In this case we usually consider matter as the "being," and the form as unessential. But simple matter, like every simple being, cannot be continually derived from something different from itself.

We have often before dismissed, as unanswerable, the questions how it is that any content can exist, and act and be acted upon as a thing. Our inquiries must, then, be what are the peculiar characteristics constituting the soul's real being, by which it is distinguishable from other substances.

We can only learn of the nature of each thing, and in like manner of matter, through its operations and effects. It is, therefore, not an error, but the natural method of psychology to define the nature of the soul thus reversely.

The first systematic attempt, in the *doctrine of the faculties of the soul*, has remained unfruitful. The multitudinous psychical activities were classified according to their resemblances, and it was, indeed, correct to ascribe to each such group of actually produced activities a *faculty*.

However, this notion was not as fruitful as that of force in physics, for the physicist only seriously speaks of a force when, not only the form of the effect is known, but when a law can be given, according to which its magnitude varies in proportion to the variation in certain conditions.

The faculties of the soul, on the other hand, were simply abstracted from the *form* of the activities and no law was found for them, thus simply a tautology was reached as, for example, in the statement that the faculty of sensation produces sensation without explaining under what conditions.

On the other hand physics has been successful only in so far as it has reduced all natural processes to motions of masses, By means of this similarity in the processes it was possible to accurately define the result obtained by the simultaneous and combined operation of various forces upon the same object. But psychical conditions can not be reduced to such a common standard.

We have no idea of what would result from the combined action of the faculties of susceptibility and of

conception. What is known concerning it is derived independently of it from experience and a knowledge of humanity.

Both these deficiencies are not to be removed by any better carrying out of the theory. It can only serve, then, as a convenient catalogue of spiritual activities but not as an explanation of them.

§3. The unproductiveness of this theory, and the poor standard it supplies for the connection of the various faculties (which it always viewed as the expressions of an individual soul) induced Herbart to attempt the explanation of all these spiritual activities and faculties as a series of results springing successively from a single primitive activity of the soul.

The soul was considered as one of the super-sensuous, absolute beings of completely simple nature, which always remain unchanged if undisturbed, and yet, when they are affected by external irritants which would produce disturbances in their nature put forth activities for self preservation. And these self-preservative efforts vary with the disturbances producing them.

In the case of other real beings, as, for example, those composed of matter, we can know nothing of the character of this process of restoring the equilibrium. In the soul, on the other hand, we know, or dare to assume, that they, in general, are in the form of conceptions.

By means of physical irritations, which Herbart did not follow further, the soul is induced to put forth this reaction, and the conceptions here occurring, *i. e.*, of simple sensations, a definite color, sound or taste, are the simple elements through the farther reciprocation of which results the whole of the remainder of the soul life.

We mention here, gratefully, only the previously mentioned explanation which elucidates the process of conception according to general mechanical laws.

On the other hand, we cannot agree with the attempt to derive all the higher activities of the soul as independent mechanical products of this process of conception without the supposition of some faculty in it not yet mentioned. This law was not indeed, considered necessary, for Herbart himself admitted that even the simplest sensations group themselves in entirely distinct classes, colors, sounds, tastes, none of which are derivable one from another; that the soul thus really possess quite distinct faculties which we cannot derive from that unity which we still insist upon.

Nothing, then, was to prevent the assumption that these sensations and their relations among one another operate as new stimuli upon the soul unit, and then produce entirely new reactions which it would, however, be impossible to derive from these sources themselves.

Such an assumption would only be met by the

demonstration that it is unnecessary, and that really all the higher activities are quite independent results of the reciprocal attrition of the simplest concepts. This demonstration has not succeeded as may be seen from the following examples.

§1. We have already found it impossible that a soul, were it but a conceiving being, should conceive of relations between its concepts other than they really are, for example, as though they were in space while they are not. If it does so, then it must add to this actual existence something new from its own nature which is not derived from the thing itself. In like manner it was found impossible to consider attention as simply the intensity of the conception itself; the subject which exerts all the applying activities in which the real office of attention consists would, in that case, be entirely wanting. We now find it quite impossible to consider feelings of pleasure or displeasure as independent results of the various positions in which the conceptions, during their progress, may become related one to another. If the soul were simply a conceiving being it would conceive all these facts accurately and indifferently, even though they were fraught with its own destruction. The fact that it partakes in an interest in them is a new fact which must proceed from some other peculiarity of its own existence.

Finally, no one could be persuaded that what we

mean when we say "I will" signifies simply the access of a conception into consciousness through a conflict with forces which attempt to prevent it.

However obscure and inexplicable the idea that in this case we have to deal with an act and not simply a *happening*—an act produced by ourselves, the unit-subject of our world of concepts—yet the fact itself which we thus designate and discover immediately in inner experience cannot be displaced by this hypothesis which throughout explains nothing, any more than the *appearance* only of such an act could present itself to us as distinguished from its simple occurrence.

We close, then, with the conviction that it is possible and necessary to credit to the unit-being of the soul more than a simple adaptability for conceptions, and that even these reactions of the first order which take place as a result of external stimuli, in the form of conceptions, may, by their relations and combinations, become new stimuli by means of which faculties of the soul not before affected are excited to expression.

§5. The explanation of the origin of the higher spiritual activities from the lower must be given up. In the place of such a *mechanical construction*, another view may be presented, which affirms that the sum of spiritual expressions, let them originate as they may, are, at any rate, suited to one another, and necessary,

hence, those *ideas* which express the destiny of the soul are completely realized.

The *Idealistic systems*, and particularly latterly that of Hegel, made this attempt. According to these, the world in general is not a simple *fact*, it has also a *meaning*. In this whole every individual has its definite position, and the being of each thing consists really in the partial idea with the realization of which it is intrusted and through which it contributes its own to the unbroken whole of the ultimate or universal idea of the world.

If we can formulate an accurate exhaustive expression for this ultimate idea, we can derive from it the form of each thing, the totality of the faculties necessary to it, and, finally, the general laws according to which these must operate in order to reach that consummation.

As, however, that definition is impossible, instead of a scientific deduction, capable of proof and counter proof, we must accept one which comb nes, with more or less taste, more or less of æsthetic correctness, the single spiritual activities with such a comprehensive expression as may have been found for this ultimate idea.

The learned conceptions which are possible in the premises, and which have not been wanting have, moreover, become one-sided on account of an historic circumstance.

The question concerning the method and truth of our knowledge or concerning the relation between subject and object has so absorbed all attention that the process by which the existing being becomes conscious of its own existence, *i. e.*, the development of self-consciousness is considered the real goal or the final content of the entire world-system. The soul appears simply designed for the solution of the problem of self-consciousness within the earthly life, and the various forms in which this office of pure intelligence is gradually performed fill nearly the whole field of psychology.

The *content* of this, however—that which is sensuously perceived, or viewed, or conceived—on the other hand, is quite as much neglected as the entire remainder of the soul life, of susceptibility and volition, which only comes under consideration in as far as it can be applied to this problem of self-objectivity.

CHAPTER SIXTH.

THE MUTABLE CONDITION OF THE SOUL.

§1. The life of the soul consists, not in a uniform possession, but in the varying operation of its faculties. In this it is in most obvious dependence upon the body. The opportunity afforded by certain disturbances of the body has made it possible to define this dependence more accurately.

Three interpretations of the observations made concerning them are, however, possible. Firstly, the organ disturbed may be the operative cause of the spiritual function which can not, therefore, be performed after its disarrangement; secondly, this organ may be the sole transmitter of the irritations necessary to the soul in order that it may be induced to put forth a function otherwise explicable out of its nature; or, thirdly, the disturbance may exert, either directly or by means of alterations which it induces in other organs, a positive activity of a repressive sort upon the soul, and this prevents, for a time, the expression of the faculty which itself persists.

Only the first of these interpretations appears untenable on account of the impossibility of considering psychical functions as self-evident products of physical

processes. If we wish to prove the two factors actually connected, one or the other of the last mentioned interpretations would be necessary in every individual case, the first alone would require further demonstration.

§2. If we understand by consciousness that which we more explicitly call the condition of wakefulness, the question arises upon what depends its opposite, *i. e.*, unconsciousness, the first example of which is normal sleep. In relation to this, it is plain that, in general, both methods of explanation are admissible, but that the entrance of sleep and the possibility of its intermission does not indicate an exhaustion of the nervous forces, so that they, consequently, are not able to produce the necessary stimuli to continue wakefulness, but, rather, a positive hindrance, in various directions minute, but as a total, constituting the feeling of weariness which lessens the interest of the soul in the carrying on of the train of thought and which, by means of this abandonment on the part of the soul, is increased in its effectiveness.

Instantaneous unconsciousness from fear appears to originate in the same way. Considered as simply a physical stimulus the frightful vision or the news heard is very insignificant and harmless. Only after our reflection, which considers the significance of it in its entire connection with our existence does this perception acquire its fearful power. Then the process of our spiritual

life may be disturbed immediately, and the bodily insensibility following may be simply the reaction of these psychical disturbances. This view is not entirely excluded in the case of unconsciousness in sickness or after injuries of the brain. The restricting influences are felt partly in the form of pain, but not necessarily so. As we are quite unconscious of the conditions prevailing in our nerves previous to sensation and only the latter enters consciousness, so, likewise, the consciousness may disappear without the workings of the forces which quenched it becoming objects of perception.

§3. It has, in recent times, been frequently thought that the activities of certain irritations conduce to the continuance of wakefulness and their absence to the production of unconsciousness.

It is concluded from experiments upon hypnotism that in the complete exclusion of external excitements of sense and prevention of motion the entire spiritual activity is so reduced that the state of wakefulness cannot be maintained, but complete unconsciousness takes place, a process which has been in a few cases observed in human beings, but which affords no trustworthy conclusion. Moreover, we know that when interest is not excited by some inner activity of the mind, as in a state of *ennui*, even the operation of external irritants does not prevent falling asleep.

Positive agencies are also known which dispose to sleep, such are, a multitude of regularly recurring rythmic motions of the body, rocking, knitting, combing, the continuous viewing of large illuminated uniform surfaces, the convergence of the axes of the eyes in squinting, etc. Lastly, the manipulations of the mesmerist belong here.

Nevertheless, upon none of these methods can certain conclusions be formed, for the instances of their inoperation are extremely frequent, and admit of a supposition of a co-operating condition as yet unknown. In all cases, however, at the very most, only the external condition, on the one hand, and its effects, on the other, are known, while the intermediate processes which connect the one with the other are quite obscure.

§ 1. If the minimum activity of the waking condition, *i. e.*, sensation of external impressions, be exerted, it does not of necessity follow that the next higher activity, *i. e.*, the consciousness of the relations between the individual impressions, should be present at the same time.

It is well-known that in our daily experience, this latter activity may be absent, as when, for example, we follow with attention some chain of thought to which these impressions are foreign, or when we are excited by painful emotions.

There are, however, pathological derangements, of a

nature, indeed, as yet unknown, which produce inadaptability for the unification or understanding of impressions perceived in sense.

§5. We do not need to assume a corporeal basis to explain the retention of the conception once received, *i. e.*, the fact of *memory*. For even in material elements we cannot discover how far it is their materiality which causes the observed persistence of their conditions.

On this account it would be equally pertinent to ascribe this peculiarity to every immaterial subject which is capable of acting or receiving action.

However, the necessity of thinking of a vast number of various mixed impressions enduring within the complete unity of the soul favors the other view that this necessity would be better satisfied by assuming a large number of elements. Not as though the impressions produce a condition of quiescence by their reactions, but, rather, according to the analogy of light and sound waves, motions are assumed which extend over many elements and, unperceived, after interaction, undergo further development. Nevertheless, it would be impossible to use this general analogy further in detail.

Each image of an approaching object would, in each instant, be the source of new vibrations which do not obscure the previous one. How a single concept of the object can result out of these; again, how two simult-

aneous motions can associate themselves so that the renewal of the one should reproduce the other without the production of a new impact; finally, how it happens that one motion, which belongs to a partial impression of a complex image, awakens exactly those others which belong with it as parts of the same image —for all these questions a physical analogy is wanting. Although this discussion seems to make a corporeal basis unnecessary, still, pathological observations show that it is, in some form, present.

The fact that those events immediately prior to the outbreak of an illness frequently are forgotten may be explained by the fact that their concepts had associated themselves with a sense of illness which is not present after convalesence, so that the key is wanting the touch of which alone could reproduce them in memory.

Nevertheless, other facts—the impossibility of recalling certain similar groups of concepts, for example, sirnames or single sayings—do not admit of explanation.

§6. The unconsciousness of sleep is of various degrees of intensity which can be measured by the magnitude of the excitements necessary to waking.

It is often incomplete in so far that, for example, irritations of the senses of feeling and hearing operate upon the consciousness and produce the consequent sensations.

As, however, in sleep, that attention, which is

exerted intentionally during wakefulness, and which is then conscious of the complete connection between the surrounding objects, chiefly through the instrumentality of the sense of sight, is absent, the sensations reproduce themselves without the selection of those which are apparently connected by their contents, or are brought into connection by some prior process of conception. Upon this fact depends the fantastic character of dreams, which very frequently collect about a very small nucleus of actual sensation complex imagery which, although concordant, is not in reality connected in the least with it.

This activity of consciousness may so increase as to permit the correct answering of questions, and it thus becomes possible for those who are awake to direct, to a certain extent, the train of thought and, perhaps, even the actions of the sleeper, for no presiding consciousness of actual relations and the personal condition opposes the direct translation of the conception excited into the resulting motion.

§7. We ascribe considerable influence over the process of all spiritual conditions to the *temperaments*, by which is simply meant an expression for the amount and kind of excitability to external impressions; the greater or less extent to which the excited conception reproduces others; the rapidity with which concepts vary; the intensity with which they unite with them-

selves feelings of pleasure and pain; and the ease with which external acts associate themselves with them. Notwithstanding the infinite variety of temperaments considered in this sense, there may be mentioned the four common ones as the most definite types:—

The *sanguine*, exceedingly mutable and with vivid excitability; the *phlegmatic,* with slightly varied and slow, but not on this account feeble, reactions; the *choloric*, with one-sided receptivity and great energy in certain directions; the *sentimental* (in place of the melancholic), distinguished by especial receptivity to the susceptibilities of all possible relations, but which is not affected by the simply matter-of-fact.

It is necessary to avoid confusing the temperaments with various pathological conditions or peculiarities of character, although it is clear that each temperament has its strong and weak side for moral culture and bodily health. We have no definite knowledge concerning the corporeal basis of the temperaments.

§8. *Phrenology* or *Cranioscopy* has claimed to discover, by external indications, a series of organs for the individual spiritual functions.

This is, indeed, without any foundation, in as far as it sought to define the position of these organs and to separate them in space. On the other hand, it is not entirely in error when viewing certain external formations as simply the indications which show that the,

otherwise unknown, conditions exist, upon which actually depend, we know not how, the particular intensity of these functions.

It is prevented from becoming such a useful collection of facts, however, by another fault. Only those functions or talents can be taken into account which are not ambiguous and, when present cannot be well concealed nor yet counterfeited when absent, for example, musical, artistic or mathematical talents, of all which we have actual examples enough of inheritance in a family.

But peculiarities of character which can be estimated only by a delicate knowledge of human nature, and not even then with certainty, and which, in a given case, may be the product, not simply of natural abilities, but of education and accident, are not at all adapted to this determination, although often so used.

§9. A *Sensorium commune* and, more recently, a *motorium commune* have been distinguished. The necessary activity of the first results from the fact that the individual impressions cannot become objects of the cognition of the soul as such but only after combination or some other adjustment. The organ has this office, the simple collection of the impressions into one place seems unnecessary. How far this process extends we do not know, apparently it may be related to the previously explained process of apprehension of

space, to which, perhaps, a large part of the brain is dedicated.

It would be assumed concerning a *motorium commune* that it combines the individual roots of the motor nerves in such various ways that there results a series of subordinated centres, each of which needs but a *single* impulse in order to set in motion at once many properly combined activities. The sort of effect which the soul exerts upon these points is certainly incorrectly conceived, if it be assumed that the impulses coming from the soul are of identical sorts and only distinguished in their effects by the direction which they take, and hence the various termini which they finally reach.

The determination of such a direction would be impossible unless the soul possessed a knowledge of the structure of the brain with which we cannot credit it. We assume, therefore, on the contrary, that every concept of motion, **a**, which arises in the soul is a qualitatively different condition from another concept of motion, **b**.

To **a** belongs the resulting condition **A**, to **b**, another, **B**. Both these conditions can only take place in those points of the nervous system which are adapted by their organization to be excited thereby, just as a glass, for example, only responds to those tones which are capable of producing vibrations in it by impact. The impulses of the soul do not, then, require to be directed,

but find the place for their application spontaneously. It should not be understood, however, that they require to pass over a distance from a given point to that place.

We should conceive the function of the organ of speech in a similar way, this being the only one which has, with considerable certainty, been referred to a definite spot in the hemispheres of the cerebrum.

Injury of this spot prevents the possibility of combining the conceived sound-pictures of a word with the excitement of motions in the muscles of speech by which the actual articulation of the sound is produced.

Although we can form but little conception of the sort of activity incumbent upon the organ, we are yet more in the dark as to the method by which such a disturbance in its activity can be produced as takes place in a pathological state of aphony.

§10. For the higher spiritual faculties which consist in the judgment upon relations of given concepts, we do not know how to prove empirically a definite corporeal organ, nor yet how to conceive how such an one would subserve for the solution of the important part of the problem, *i. e.*, the production of the act of judgment itself.

It is conceivable, on the other hand, that this higher activity might be the complete and clear representation of those contents upon which judgment is to be passed, and hence might be considered but the undisturbed

function of those organs which contribute, first, to the sensuous perceptions, then, to their reproduction and connection with others, finally, to the proper connection with the feelings of the value of each.

§11. There remains to be considered a large number of statements concerning abnormal spiritual activities in conditions of bodily ailment. The various instances of such cases are not all equally incredible. The assumption that cases exist of an immediate communication of consciousness with distant parts of the external world without the agency of the physical, cannot be dismissed *a priori*, for all mediate perception must be reduced, in the last instance to immediate. Experience only can teach us when physical mediation is present and when not. Certain it is that the entire wakeful and spiritual life, which alone is amenable to accurate experimentation, is connected with the external world by physical mediation.

Senseless is the assumption, on the other hand, that the given appearances may be explained throughout by the operation of that animal magnetism which is supposed to be discovered. Again, it is not impossible that a simple sensation, such as that of light, can originate in nerves not designed for them, but it is quite impossible that an orderly apprehension of a multiplicity of sensations, for example, the reading of a letter, should take place in superficial nerves which

are not, like the optic nerve, constructed for this combination of impressions.

Finally, it is possible that various spiritual functions take place more vividly in such pathological conditions as diminish the regular intercourse with the external world, and thus remove those little cares and the timidity which in ordinary life stand opposed to the exercise of a given faculty.

In these cases, for example, when a problem is solved in somnambulance which was before insoluble, this only takes place through the agency of those faculties which have been cultivated during the wakeful state. That nothing higher is reached in this condition than is attainable in a waking condition is shown by the unimportant content of all the disclosures received in it, and by the fact that the multitude of such cases have not combinedly produced any advance in our knowledge.

CHAPTER SEVENTH.

THE REALM OF SOULS.

§1. We have no reason to speak of a soul at all except where, without this assumption, facts would be incomprehensible. In reality, however, such inspiration may extend further than required by this test. An *inspiration of all things* has been conceived of, but this thought, although there may be good ground for it, has, as yet, remained unfruitful for the explanation of individual appearances.

In sooth, plant-souls have been bespoken with great partiality, (Fechner, Nanna, oder ueber das Seelenleben der Pflanzen; Leipzig, 1848,) and certainly inspiration is not connected with the centralized structure which we observe in animals and fail to find in plants. Nevertheless, the more the organization of the plant, and hence the expressions, by means of which alone its inner life can become an object of our knowledge, varies from that structure, so much the less does it become possible to produce from this phantasy (although it may be correct) an object of science. The animal kingdom, then, alone remains as affording us such an ascending series in spiritual life.

§2. It would be a mistake to consider all animal souls as beings originally of the same sort, which either were afterwards furnished with powers or were adapted simply by the diversity of the external impressions for the greater or less development and the peculiarities of their spiritual perfection.

We consider "soul," as before, only as a title which applies to all those beings which experience their inner conditions and the reactions from excitements in the form of concepts, susceptions and volitions.

But that which is expressed by this term in common phrase, *i. e.*, the real *being* of the soul, may differ as essentially as we consider gold, silver and lead to do, although they only show this diversity by the differences in the degree of the same physical qualities, weight, cohesion, hardness and others.

The question may arise where the idea of the instinct of animals comes in, to which is to be reckoned not simply remarkable instinctive impulses but the entire typical life of all lower animals. Perhaps, for example, in the lower classes the souls are not prepared to the same extent for learning from experience, but, in agreement with their bodily organization, have an original content in consciousness by which they are regulated in the same way that we are sometimes by the accidentally formed ideas of dreams. However, this assumption cannot be fruitfully pursued.

As a farther assistance in the explanation it may be added that, in an entirely different organization of the nervous system, perhaps the vegetative processes, of which we are quite unconscious, are objects of perception and starting points for acts which appear reasonless to us. Not less probably, there may exist sensations of external circumstances, the organs for which we do not possess, as, for example, sensitiveness to minute electric variations in the environment from which might result sensitiveness to changes in the weather, not as premonitions of the future, but as perceptions of what already exists. Nevertheless, it is wrong to refer all animal soul-life to such instinct. For certainly there exist in their actions accommodations to circumstances in such a way that the same reflection and use of experience, upon which our every day existence rests must exist in them as well.

§3. If the *understanding* and its activity, *thought*, are to serve as the distinguishing characteristics of humanity we must insist that the understanding does not simply allow the process of conception to go on according to mechanical laws, but puts forth an activity which separates those conceptions not belonging together and not merely *permits* those belonging together to remain so, but causes them to be at once conceived in the form of general notions or laws indicating that they *belong* together.

There is no occasion for referring such comprehensive reflection to animals in order to explain the purpose seen in their activities, and the way in which they adapt themselves to circumstances. The ordinary processes of conception (inasmuch as even they gradually associate themselves according to their affinities) serve quite as well for them as they do even for man in the greater part of every-day life.

If the *understanding* or *thought* be considered as a distinctive character of man, the following circumstances may be mentioned which favor its development:—The long period of helpless childhood, which makes the collection of many experiences possible; then the skilfulness of the hand which makes man a born experimenter, and permits a multitude of connected observations; finally, speech, partly because the sound images, as symbols of conceptions, serve to fix their content and make possible the combination of many conceptions into an object of internal contemplation; partly, and chiefly, because communication causes a further development of each individual process of conception through the stimulating, enriching and correcting supervention of new chains of thought.

§4. *Reason* is considered the most definite peculiarity of man, and by this is understood the faculty of perceiving immediately *eternal verities* in itself whenever external experience has furnished to consciousness the

facts concerning which it has to form a judgment, particularly concerning moral propriety or impropriety.

We know nothing regarding the primal psychological origin of this simplest law of our knowledge and hence have reason to consider it one of those reactions in the original nature of the spirit which can never be explained by the external occasions which are, nevertheless, necessary that it may be awakened, although this explanation has been attempted.

It is, moreover, indifferent whether they be considered as inborn endowments or acquired by experience in life, if it only be admitted that, after it has been formed, it is the expression of truth, found, indeed, in experience, but, as to its content and value, quite independent of it.

§5. Moral truths are designed to govern the *will*. Of this, in like manner, we only speak in the case of man, according no volition to the acts of animals because we consider their acts as simply the natural results of *impulses* but not as acts of a will. Impulses are originally but feelings, and chiefly those of displeasure, or of unrest. They are usually connected with incitations to motion which, after the manner of reflex motions, lead to all sorts of motions which have proven, after more or fewer errors, the proper ones to allay that discomfort. Then after the feeling of discomfort has combined with the concept of that act by which the

discomfort was allayed, a real impulse is formed which has a goal to reach, and which sways the acts of the soul. In the same way many operations of human life are performed which we incorrectly say are *willed* when, in fact, simply no will was exerted to prevent their taking place.

We can only speak correctly of *will* when the motives of various actions and their values are compared in full consciousness, and then a choice is made between them. It is quite unreasonable to assume that we express by the words "I will" no more than is involved in the future tense "I shall." This would only be the case if the verb, the future tense of which is used, itself means an act in the notion of which there inheres the idea of volition. Unprejudiced observation must admit that the peculiar approval of a conceived act or the adoption of a resolution, however impossible it may be to construe it, is an actual process within us, inexplicable by the mechanism of conception.

§6. And if this characteristic of the will be conceded it would be expected, from the standpoint of explanatory science, that the utterances of the will would be determined by definite laws. If ethics assert the freedom of the will psychology need not be appealed to to decide, on the basis of, so-called, experience, whether this freedom is possible.

It is not true that we find in our subjective observa-

tion the determining causes of all our acts. Very often we find nothing, and, even where we think we have found something, it is ambiguous, for if the motives for two opposed acts, **a** and **b**, have been long compared in reflection, and then a decision in favor of **a** is formed, it will always afterward appear as though the reasons in favor of **a**, by their forcefulness had mechanically subdued those for **b**, and this semblance would result just the same if the decision in favor of **a** had been really reached by a completely undetermined freedom.

It must be relegated to *metaphysics* to inquire whether the notion of such freedom is harmonizable with our universal apprehension of the world, and to *practical philosophy* to inquire if it promises the advantage which caused its employment.

PART THIRD.

THE STRUCTURE OF THE BRAIN.

—BY—

C. L. HERRICK.

STRUCTURE OF THE BRAIN.

PRIMITIVE ELEMENTS.

§1. The animal body, complex and mysterious as it seems, and diverse and complicated as its various organs really are, is composed of nothing but cells and cell derivatives.

As stated by Lotze, it is impossible to avoid conceiving of man as a unit-entity surrounded by or resident in a heterogeneous agglomeration of corporeal units, and yet it is impossible to picture to ourselves the way in which the various processes which bring about sensations and which are really only states in various unlike bodily elements transmit the perfected product to our spiritual apprehension. However, although there is no physical analogy for the process it must be accepted as a fact, and we may, at least, be interested to learn just what adjustments in the body are necessary to such and such spiritual affectations, and through what mediation the spirit controls the body.

The nervous system is no exception to the above statement, and all of that wonderful mechanism which we call the brain, and which is the physical basis of character and the soil in which the soul, in its corporeal

relations, is rooted, is a mass of cells and cell products like the muscles and bones which do its bidding.

§2. All of these simplest morphological elements are descended, in the case of every individual, from one, or rather, two primitive cells—egg and sperm. Only in the lowest group of animals, *Protozoa*, does the entire organism consist of but a single cell. In this case the cell as a whole performs all the functions devolving upon a vital being, and, in the absence of nervous organs, the whole animal may be said to do the thinking and feeling as well as feeding and moving. This primitive condition is never entirely lost in any living cell however highly differentiated the animal, and however restricted, as a consequence, the functions of the individual parts may be. The last function which could be given up would be nutrition, for should a cell become too highly specialized to take nutriment its life would at once be lost. It is found, moreover, that others of the original functions persist, though to a different extent in different types of cells, in many of the cellular elements of the body. In animals of a higher rank than the Protozoa differentiation is inaugurated by the subdivision of the primitive cell into numerous similar bodies and finally into groups of such cells, the functions of which differ with their position.

§3. Ordinarily, the first stage in this process is the

formation of a loose aggregation of cells called the *morula*, after which a central cavity may be formed by the further subdivision and growth of the peripheral cells, and a hollow sphere called the *blastula* results. A portion of the cells may now become invaginated so that a double sack is formed. In this, or in analagous ways, a body, consisting of two germ layers, *ectoderm* and *entoderm*, arises, and from these two layers of cells all the parts of the body are produced by similar processes of invagination or by the migration of groups of cells to the cavities between these germ layers. In such animals as never pass beyond the *gastrula* stage the ectoderm commonly furnishes the cells charged with locomotion and nervous functions, while the entoderm is charged with nutrition. Even in higher animals, in which these systems are perfectly distinct in adult life, the organs of locomotion and enervation spring primarily from the ectoderm, while the digestive system is only the greatly modified entoderm.

§4. In the process of development, the cells, once similar, become greatly modified, and it is only by the help of high powers of the microscope and the delicate manipulations of modern histology that the cellular character can be discovered in many tissues.

Nervous tissue consists, in general, of two distinct elements—ganglion cells and nervous fibres. The latter may be considered as simply appendages to the

former. The cell, as we have seen, is the unit of structure, and as nerve cells are designed to exert their influence in all parts of the organism, it is evident that when differentiation of the body removes the generators of nerve power from immediate contact with the parts to be affected there must be provided conducting channels of nervous matter to transmit the excitation. This is the office of the nerves.

Nerve cells vary greatly in form and size, but consis of a nucleated, pigmented mass of sarcode, usually with no true cell wall, and giving off nerve fibres composed of a similar substance. Some nerve cells are so large as to be visible to the unassisted eye, while others are among the most minute morphological elements.

Nerves are essentially bundles of minute fibres insolated by various protective sheaths. As a nerve issues from its cell it is usually without a sheath, and then consists only of a bundle of nerve fibres constituting the, so-called, *axis cylinder*. This, the essential portion, is surrounded by two sheaths which unite, node-like, at intervals. Each nerve is thus a bundle of *primitive* fiibrillæ surrounded by the *medular sheath* and the *primitive sheath of Swann*.

§5. Of both these elements, ganglion cells and nerve fibres, there are two sorts, motory and sensory. All the various procssses of mental life may be divided into two primary groups; first, those concerned with influences

from without and, second, those which are designed to exert influences upon the bodily organs. So far, at least, as the simpler acts of mind are concerned, they may be said to consist of shocks from without and reactions from within, hence we expect to find, as we do, that the centripital and the centrifugal channels are connected by linking nervous threads. The simplest connection of a nervous system will then picture to us a sensitive apparatus upon the surface of the body which selects certain of the many external irritants to transmit to the brain. Here the nerve terminates in a ganglion cell which is excited to action, the kind of action being determined by the character of the stimulus, its modification in the organ of sense, but particularly by the structure of the ganglion cell itself. We must avoid considering the activity of the ganglion cell as *caused* simply by the impulse which is received from the nerve. The nerve furnishes the *occasion*—the form of the reaction depends upon the structure and position of the cell. The third link in this chain of processes is the transmission of this new and different stimulus to a ganglion seated at the root of a motory nerve. Here again it is conceivable that the character of the excitement is completely changed in a manner dependent very largely upon the position and structure of the motory ganglion. The last nervous process is a state of excitement transmitted through the motory nerve which acts like an electric shock upon various muscles

at the peripheral termini causing contractions in the sensitive myolon material.

All the above processes are explicable according to physical analogies, but this does not explain in the least how any of these processes are brought into relation with the soul so as to excite in consciousness an apprehension of external happenings or internal states.

We discover from experience that sensations from various organs as well as the most diverse mental states succeed in producing activities in one and the same motory centre, so we are prepared for the discovery of anatomy that there is the most intimate anastamosis of the various ganglion cells, so that the simple picture drawn above must be filled in with many details. No ganglion is affected without transmitting more or less of its agitation to neighbouring parts, and the intimacy of connection is different in different sets of cells; thus the perfection of the brain as an organ of mind depends as much upon the perfection of the correlation and subordination of the various parts as upon the size and delicacy of its material.

CHEMICAL CONSTITUENTS.

§6. Before taking up the more intimate description of the brain, it may be well to mention some of the chemical peculiarities of nervous matter. Although little is known of the composition of the materials in which nervous functions reside, it is at least certain that

they are very complex and in a state of very unstable equilibrium. Of these substances Lecithin, Cerebin and Cholestrin, having the formulas $C_{44}H_{90}NPO_9$, $C_{37}H_{23}NO_3$, and $C_{26}H_{44}O$, respectively, are most im-important. Lecithin is a substance resembling fat, composed of the radical of the fatty acids, phosphoric acid, and clycerine, united with the amine base, Neurine. In addition to these are various albuminous compounds from which the above may be derived. Another substance, Nuclein, is among the elements but is found in the nuclei of all active cells, so that it cannot be reckoned among the necessary constituents of nervous matter. The primitive fibrillæ, as well as the nuclei of the ganglion cells are rich in albuminous matter, while the protoplasm of the ganglia and the nerves seems to be largely made up of Lecithin and Cerebrin. This much is clear, that the physical force liberated in all nervous processes is derived from the decomposition of the highly complex and unstable molecules of the nervous tissues. The materials needed to supply the waste thus produced are afforded by the blood, although some of the specific nervous compounds seem to be the result of a synthesis produced on the spot where they are needed from materials richly supplied by the general circulation. (For a valuable discussion of the way the force resulting from the chemical changes taking place in the nervous matter of ganglia and nerve cells is applied, or the "physiological

mechanics of nerve-substance," see Wundt, Grundzuege der Physiologischen Psychologie, Chapter VI., under the above caption.) A further discussion of this subject is not here permissible.

FORM AND DEVELOPMENT OF THE CENTRAL PORTION OF THE NERVOUS SYSTEM.

§7. The earliest condition of the nervous system which we need to notice finds the brain and spinal cord in the form of a hollow cylinder somewhat expanded and modified anteriorly. This front or brain portion now begins to grow much more rapidly than the rest and its walls expand and become variously folded upon themselves and almost all of the complicated mechanism of the brain in man is derived from repetitions of this process of in- and evagination of the walls of the primitive neural tube. Three expansions appear at first, forming the first indications of the differentiation about to take place. The anterior of these prominences divides to form the cerebral hemispheres and optic thalmi, the middle one forms the optic lobes or corpus bigeminum, while the posterior one produces the cerebellum and medula oblongata. (Fig. 1, Plate I.)

The separate chambers thus formed are still connected with each other and the central cavity of the spinal cord. (Fig. 2, Plate I.)

Now begins a separation of the above-described

organs into pairs, a process which is nearly complete in the case of the hemispheres; the thalmi optic open outwardly; the separation is simply indicated in the case of the lobi optici; while the cerebellum divides and again unites. As a result of this process, of course, the cavity within is greatly modified, that contained in the hemispheres becomes separated into two, called the first and second ventricles, that portion within the thalmi is called the third ventricle. The opening in the medula is called the fourth ventricle and is connected by a narrow canal (the *aquæductus sylvii*) with the third ventricle. There is also a small cavity connecting the cerebellum with the brain basis. The most remarkable change which now takes place is the change of position in the anterior portion of the nervous axis. At first the brain is obviously the continuation of the spinal cord, and so remains in fishes and amphibians (Fig 3, Plate I), but in higher vertebrates great flextures change the original position, and great and unequal growth obscures the original relations. Two important changes thus brought about may be mentioned. First, the excessive development of the cerebrum causes it to extend beyond and overlap first the corpus bigeminum and finally the cerebellum; second, the growth also causes foldings and impressed lines called fissures, the first of which to appear is the fissura silvii. Another fissure is opposed to the silvian and nearly at right angles to it—the fissure of Rolando or medium sulcus.

By this means the cerebrum is divided into lobes, of which the frontal, parietal and occipital are most important. In man, the whole surface of the cerebrum is thrown into convolutions which conform more or less to the direction of the principal sulci mentioned (Fig. 4, Plate I).

The spinal cord is that portion of the primitive nervous tube which changes least, but, notwithstanding, great changes in form and structure are encountered here also. The central canal becomes reduced in size and the whole is divided into two symmetrical halves by a longitudinal fissure both before and behind. These halves are connected by two commissures or nerve bundles—the anterior and posterior commissures. The substance of the cord is composed of grey material or ganglion cells collected in two masses in the centre of white external matter consisting of threads passing forward toward the brain. The nerves which spring from the anterior or ventral side are motory while the posterior roots supply sensitive nerves. (Fig. 5.*)

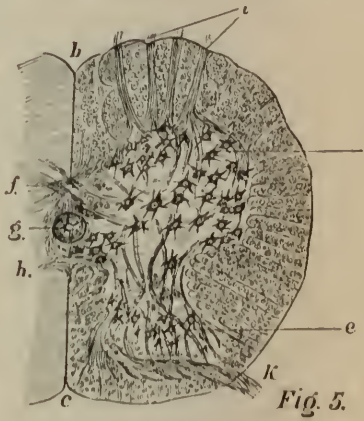

Fig. 5.

*Fig 5.—*Transverse Section of the Lower Part of the Spinal Cord.*

b, Anterior; *c*, Posterior median groove; *g*, Spinal canal; *k*, Posterior; *i*, Anterior nerve roots; *d*, Anterior cornua, with larger cells; *e*, Posterior cornua, with small ganglion cells; *f*, Anterior; *h*, Posterior commissures.

The medula oblongata is simply a somewhat modified anterior portion of the spinal cord, and the rather simple arrangement of the nervous fibres is here exchanged for a more complicated order. The longitudinal fibres group themselves into various bundles called the pyramids, the lateral and posterior bundles, which latter forms the funiculus gracilis, funiculus cuneatus, etc. Upon the pyramids is seated a pair of peculiar prominences called the olives.

The cerebellum is differentiated early, and, like the other parts of the brain mantle, as distinguished from its basis, consists of an external or cortical layer of grey or cellular matter, which in man, is thrown into strong convolutions, thus presenting in section the regular figure known as the arbor vitæ. The cerebellum receives several distinct bundles of nerves, the lower of which forms the *processus ad med. oblongatum*, the upper being the *processus ad corpus bigeminum*. From the sides issue the *processi ad pontem* which unite to form a band of fibres bridging over the medula, and hence called the *pons valori*. (Fig. 6.*)

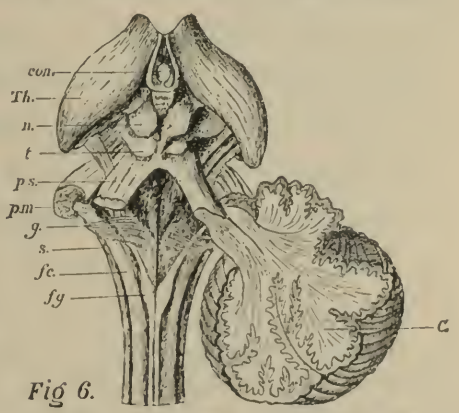

Fig 6.

*Fig. 6.—*Basal portion of Brain from above. (A portion of the cerebellum is removed.) *Th*, Thalmi optici; *Con*, Conarium; *n* a. d *t*, Corpus bigeminum

The spinal cord is produced forward after passing, as we have seen, through the medula, as the two *crura* which support, like stalks, the hemispheres. Seated upon the crura, and forming with them parts of the basis of the brain is the *corpus bigeminum*. The position of the *thalmi optici* has been already referred to as forming the walls of the third ventricle. From the front of this chamber two small openings, the foramina of Monro, lead into the two ventricles of the hemispheres. There is a small appendage below the thalmi called the *hypophysis*. The two hemispheres are united in mammals by a strong, thick band—the *corpus callosum*. The crura, or extensions of the axis of the spinal cord, unite with the hemispheres, and near this point of union is accumulated a large amount of grey cellular matter, forming a prominence projecting into the lateral ventricles called the *corpus striatum*. We need not proceed farther with the description of anatomical details.

The histology as well as the configuration of the cerebral elements associate them in two groups. The first, consisting of those parts which are the direct continuation of the spinal cord, constitute the basis of the brain, and agree with that organ in having the grey matter

(nates and testes); *Ps*, Pedunculus cerebelli superior (Processus ad Corp. bigeminum); *Pm*, Pedunculus cerebelli medialis (Processus ad pontem. Between *Ps*. and *Pm*. is seen the Pedunculus cerebelli inferior—Process ad med. oblongatam); *g*, Girdling fibres; *fc*, Funiculus cuneatus; *fg*, Funiculus gracilis; *s*, Funiculus lateralis; *C*. Cerebellum.

arranged about the canal, or at least, medianly, while that part of the brain, including the cerebrum and cerebellum, which forms a covering for the others, has the cellular elements arranged cortically in a more or less thick layer, below which are white fibres passing downward toward the base of the brain to find exit with the medula. The cortex of the brain is about 2 mm. thick and, as a whole, as well as in its cellular elements, is invested with a web of delicate threads of connective tissue. This *neuroglia* serves not only to isolate the cells, but to convey blood vessels to each individual cell. These cells, which are, perhaps, the most important of the cerebral organs, are arranged in layers, the superficial layers containing smaller, the deeper layers larger cells. The nerves coming from peripheral parts first, after reinforcement in the base of the brain, contribute their stimuli to the superficial or sensory cells. The resulting activity in these smaller cells seems then to be imparted the larger or motory ganglion cells, from which the impulses there generated are conducted again to the base of the brain and, after correlation and various modifications, an impulse to motion is transmitted to the appropriate muscles.

Nervous threads are thus either centripital (sensory) or centrifugal (motory)—names derived from the direction in which the nerve is adapted to transmit impressions.

THE CONNECTION BETWEEN THE BRAIN AND OTHER PARTS OF THE NERVOUS SYSTEM.

§8. The sensory nerves spring from the posterior part of the spinal cord while the motory threads arise anteriorly, and the continuation of these nerves toward the brain within the spinal cord maintain, in general, the same relations. There is, however, a crossing of a certain portion of the fibres, especially in the case of sensory nerves. This is a provision against accidents. In general, however, the anterior and posterior nerve bundles represent the nerve roots of the corresponding sides while the lateral bundles contain fibres from both.

By dividing the spinal cord on one side there results a total loss of motion and increased irritability on that side, and diminished power of motion and irritability on the side opposite. In the medula, also, there is a crossing of fibres from one side of the body to the other which occurs in different sets of nerves at different points. The cutting of these nerves above this point causes total loss of motion to the portion of the opposite side of the body supplied by their termini.

The *cerebellum* is connected directly with the spinal cord by the fibres of the processus ad med. oblongatum. The processus ad pontem sends fibres down to end in the grey cells of the bridge from which connection is afforded with the corpus striatum and other anterior centres. The fibres passing toward the cerebrum enter

the cells of the red nucleus of the crown of the crura. It is not known that any of the fibres pass directly to the cortical substance of the cerebrum. It therefore appears that sensory fibres transmit stimuli to the cerebellum which do not produce sensations because they never reach directly that part of the brain over which consciousness bears sway, but that the excitations are transferred to ganglion cells at the base of the brain where the stimuli necessary to produce motion are set into operation immediately. If this be the case we are prepared to understand how the cerebellum comes to be the seat of reflex and automatic activities as is usually maintained. Thus the function of the cerebellum seems to be in part the same as that of the grey ganglion cells of the spinal cord, which, in like manner, form secondary centres independent of the consciousness through which sensory stimuli switch off, as it were, from the regular routes to the brain, to be transferred to appropriate motory fibres.

From the optic thalmi, corpus striatum, and other basal portions of the brain fibres pass to all parts of the cortex of the cerebrum, and, as some recent authors claim, the former is receptive to sensory nerves, optic, auditory and olfactory, as well as those of ordinary sensation, while the latter is the starting point for motory nerves. It is farther assumed that after the sensations are transformed into appropiate stimuli and these are co-ordinated they are transferred directly to the small cells in

the periphery of the cerebral cortex giving rise to sensation. Then, it may be, new forces are developed, accompanied by chemical decomposition and the evolution of heat. These forces are conveyed along the nervous threads springing from the small cells to the larger deep-seated cells of the cerebral cortex, (Fig. 7.*)

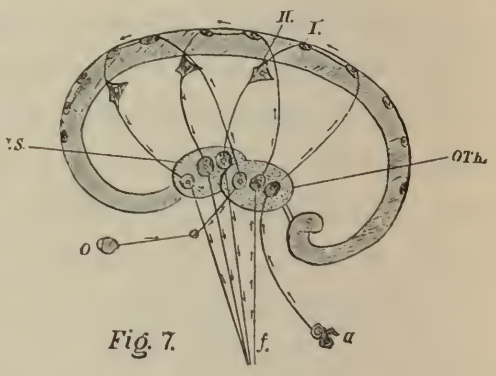

Fig. 7.

and here, as in new generators, motory impulses are produced, and these are conveyed to the corpus striatum where correlations and combinations are affected, which result in the production of more or less complicated and prolonged motions of the body, in which they are assisted and partially controlled by unconscious processes carried on in the grey matter of the cerebellum and spinal cord.

Such, most simply expressed, is the present view of simple cerebral activities. The details† which fill in and complete this outline are abstruse, and only obtainable by recondite researches.

*Fig. 7.—*Diagram of the Courses of Nervous Stimuli, according to the theory of Luys.*

O Th., Optic thalmi; *CS.*, Corpus striatum; *O*, Eye; *a*, Ear; *f*, Nerve transmitting ordinary sensations; *I*, Small (sensory) cortical cell; *II*, Large (motory) cortical cell. The course of the currents indicated by arrows.

†The above statements with reference to the functions of the optic thalmi are taken from *Luys* and may be found in Recherches sur le système

PHYSIOLOGY OF THE BRAIN.

§9. The simplest function of the central organs of nervous system is *reflex activity*. In its simplest form this would consist of the transference of a sensory stimulus directly to a motory nerve. Practically, however, it is necessary that the sensory affection should undergo a change before it is suited to act upon a muscle. Organs for this purpose, as we have seen, are the ganglion cells of the spinal cord, medula and cerebellum.

Simple reflex activities lodge in the spinal cord, while those of a higher order occur in the medula. Breathing, swallowing and the beating of the heart are such activities. Certain conditions in the capillaries of the lungs, for example, produce excitements in nerves passing to the medula which, without the aid of consciousness or of the will, produce the necessary muscular exertion to cause inhalation, while, ordinarily, no such effort is exerted in expiration. Reflex activities are found to be intimately connected, and this is explained by the various intimate anastamosings which takes place between the cells of the medula. Thus quickened breathing

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nerveux; or, in English, in the Brain and its Functions, by the same author, forming one of the volumes of the International Scientific Series. The writer is forced to admit that these views are far from proven, and, indeed, are contradicted by the results of many experiments. Nevertheless there can be no doubt that such a relation as is here described exists between *some* of the cells in the brain, and if not *these*, it matters little for the present purpose. In the case of the corpus striatum facts seem unanimous.

causes accelleration of the pulse, and certain affections of the gustatory nerve are accompanied by reflex motions in the mimic muscles of the face. It is found that the brain exerts a restricting influence upon the reflex activities so that the removal of the hemispheres increases the reflex actions. This may, perhaps, be explained by supposing that that part of the stimuli which would normally be transmitted to the cerebrum is deflected upon the subordinate fibres leading to reflex centres.

Automatic motions are a subordinate class of reflex activities in which the stimulus does not come from without, *i. e.*, is not adapted to produce sensation, but consists of a change in the condition of adjacent internal organs.

The vast majority of such motions seem to be produced by changes in the circulation or in the blood itself. The tensity of the muscles of the capillaries and the beating of the heart is regulated automatically, as is the breathing in part.

Experiments seem to prove that the *cerebellum* is designed, through the correlation of various sensations, for the regulation of voluntary motion as well as for certain reflex activities of a different sort. The removal of the cerebrum causes dizziness, uncertain gait and, often, undesigned motions, although the will is easily exerted, and the connection of the motor roots with the corpus striatum is unbroken.

Of the functions of the cerebrum it is not necessary to speak farther. What the physiological basis of the higher spiritual functions is we are quite unable to say.

The accompanying diagram indicates portions of the cerebrum which have been found, with greater or less certainty to be connected with the perception of certain classes of sensations or the production of specific motions. (Fig. 8.*)

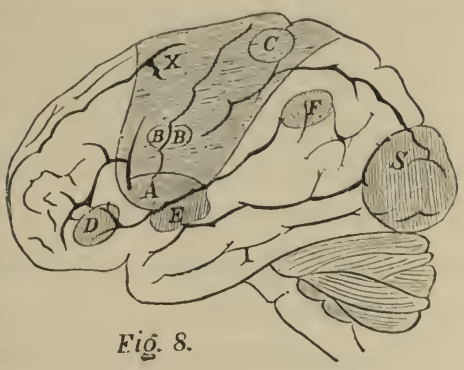


Fig. 8.

DEVELOPMENT OF SENSORY FUNCTIONS.

§10. Our knowledge of sensory functions is derived from investigations of the anatomy of the external organs of sense, but also in part from the behaviour of animals when affected by different stimuli. Such investigations seem to place it beyond peradventure that all the more complicated sensations and sensory organs are derived from the differentiation of primitive sensations and organs originally identical.

Ordinary sensation, including the sense of touch, of temperature, and muscular sense, seems to be the starting point.

*Fig. 8.—*Motory Centres of the Brain.*

A, Motory centre of Facialis and Hypoglossis region; *B*, Motory centre of arm muscles; *C*, Motory centre of leg muscles; *D*, Motory centre of speech; *E*, Sensory centre of speech; *F*, Visual region (?); *S*, Visual region.

In the most lowly animals the sarcode which constitutes the entire body must be the seat of every sensation by which the animal can be affected. It is assumed that those irritants which produces motions in the sarcode also give rise to sensations, but that these will exhibit as diversity from each other in proportion as one part of the body is different from another. Light probably is perceived only as warmth, and even those pigment flecks in the Infusoria which undoubtedly serve to absorb and thus condense the light may not give rise to the sensation of light.

The development history of the organs of sense supports the idea that all sensory functions are derived from those of ordinary sensation.

The development proceeds in two ways; first, the sense of touch becomes more highly differentiated by the development of special tactile organs; second, organs adapted for specific sensations are produced, so that the nerve termini become sensitive to special stimuli, such as light, sounds, tastes and odors.

In all cases, however, these organs are produced by modification of the outer surface of the body.

The development of the tactile sense is earliest, and goes hand and hand with the production of special organs of locomotion. The clothing of cilia found in the Infusoria serves both purposes at once. In the case of insects we find sensory organs composed of rods seated on the enlarged termini of nerves, the rods

being simply designed to communicate motions to the sensitive cell below. (Fig. 9.)

This constitutes a transition to the more highly developed tactile organs in which epithelial cells of peculiar form enclose or include the termini of sensory nerves. The teeth, nails and vibrissæ are examples of accessory tactile organs in higher animals which are not themselves sensitive, but stand in intimate relation to the nerves.

In cases where no special apparatus is developed—and this applies to the majority of our sensory nerves—the ends of the nerves seem to be free between the epithelial cells.

Special organs of touch occur in the skin and in various inner organs, as the capsules of the joints and the mesentaries. *Tactile spheres* consist of two or more cells in a capsule, between which are disc-like organs usually parallel to the surface. (Fig. 10.) The office of these organs appears frequently to be the intensification of the pressure, etc., or its direct application to the nerve.

Among the specific sensory organs those of taste and smell seem morphologically most nearly related to the organs of touch. Among lowly forms both these senses seem to be lodged in the same organs or the functions are not yet distinct. Organs, not only for recognizing but for producing odors, seem to be present in certain insects, as butterflies, and serve to assist the

sexual instincts. The termini of the olfactory nerve correspond to the simple condition of the organ of touch where it consists of rod-like bodies seated on the nerve cell. In the sense of taste there is greater differentiation and the cells which constitute the termini of the nerves are enclosed in beaker-like groups of cells which are situated below the surface. Similar organs under the skin of fishes have been thought to indicate a sixth sense. (Figs. 11 and 12.)

The organ of hearing seems to have been derived from the transformation of a ciliated surface. It is possible that even in the ciliated Protozoa the cilia, which are so easily affected by sound waves, may render them recognizable. Most invertebrates and some vertebrates possess ears which consist of cavities lined with cilia and containing otoliths which seem to communicate the oscilations produced by sound waves to the cilia and thence to the nerve. An advance on this simple ear, which can hardly be supposed to distinguish different tones is furnished by such as have the cilia or rods of different sizes and lengths, each length apparently corresponding to a definite wave length. Hensen (in the *Zeitschrift für Wissenschaftliche Zoölogie*, xiii, p. 374) claims to have demonstrated by immediate observation that different filaments respond to differences in pitch. In many insects otoliths are wanting, but the rods are more solid and are covered by a tense membrane acting like a tympanum. The various classes of verte-

brates, beginning with the fishes, exhibit a gradual differentiation and increase in complexity. The auditory sac, which is usually bi-lobed, develops on one side the semicircular canals, and on the other the cochlea. (Fig. 13.) The perfect ear is a wonderfully complex organ, the physiological significance of the various parts being but imperfectly understood. It has been supposed that certain modified epithelial cells covered with cilia of various lengths serve to record the varying pitch of tones. This, so-called, *organ of corti* has been compared to a harp, each string of which is attuned to respond to a definite tone. The most credible hypothesis seems to be that the analysis of a harmony into different tones is accomplished by the membrane lining the cochlea, the varying width and tensity of which may make it better adapted for the purpose than a series of rods of varying length. Wundt supposes musical tones are distinguished in this way while tones which are composed of irregular vibrations, *i. e.*, noises, may be recognized by the bundles of hairs before mentioned. Other parts of the organ seem to be designed to concentrate the sound waves, or to serve as dampers upon the receiving organ.

The organ of vision consists essentially of a receiving nerve and deposits of light-absorbing pigment. If the pigment flecks found in certain Infusoria, and especially in many low worms where they are closely connected with the central ganglia, are really eyes, we have in them

examples of this simplest condition. In rotifers, etc., the cells in which the pigment is deposited are peculiarly modified and furnished with rods which are primitive retinal rods—a kind of structure present in all higher eyes, and indicating a power of distinguishing between various visual impressions. The next step in the development is marked by the addition of modified, transparent cells serving as lenses to concentrate light upon the retina cells. (Fig. 14.) In the compound eyes of insects a large nuumber of lenses, each fitted to but a single rod or retina cell are grouped together like a mosaic and it is necessary to suppose that the fragmentary images produced by each lense are united in the central ganglion into a continuous representation of the field of vision. This theory is called that of mosaic vision. The eye of man is not modeled after the compcund eye of insects, but upon the simpler type offered by worms and mollusks.

The pin-hole camera, a device by which a dim image is produced in a dark chamber by rays of light entering through a minute aperture, is mimiced by the eye of the nautilus. (Fig. 15.) A second chamber in which is developed a lense changes the pin-hole camera to a photographer's camera in which lenses secure the distinctness of the image, while the larger size of the aperture greatly increases its brightness. An illustration of this sort of an eye is furnished by the higher Cephalopoda (Cuttlefish). (Fig. 16.)

The eye of vertebrates differs from that of the cuttle-fish chiefly in the fact that the elements of the retina are arranged in the reverse position. This is due to the greater complexity in the embryological development of the former, so that the epithelial layer out of which the retina is formed suffers a double instead of a single invagination.

The accompanying diagram (Fig. 17) indicates the arrangement of the various elements of the retina. It is proven that the rods and spindles are sensitive to light while the ganglion cells and the filaments of the optic nerves are not at all so, though they are more immediately exposed to its action. The ends of the rods are imbued with a purple red pigment which is excessively sensitive to the influence of light, changing rapidly in color when exposed to it. This pigment is constantly renewed by the process of nutrition during the life of the animal.

The optic nerves pass to the corpus bigeminum and usually cross, or form a *chiasma* in their passage. This crossing is only complete when the fields of the two eyes are quite distinct. The larger the part of the field of vision the two eyes have in common, the more near the optic-nerve fibres are to being equally divided. (Fig. 13.) In man it is found that the fibres passing to the inner half of the two retinas cross while those from the outer half pass directly to the portion of the corpus bigeminum on the same side.

A destruction of one half of the corpus begeminum results therefore in the blindness of half of each retina, while binocular vision is still possible for the remaining halves.

The above outline touches upon a few points which may serve to introduce the reader to a line of study second to none at the present time in interest and importance. For a careful review of the whole field refer to Wundt's Physiological Psychology.

PLATE I.

Fig. 1.—*Embryo of Chick.*

Fb, Fore-brain; *Mb*, Mid-brain; Mb^1, Cerebellum; Mb^2, Medula oblongata; *Au*, Auditory vesicle; *Pr.* Primitive vertebræ; *Mf*, Mesial or neural fold; *T*, Caudal lobe.

Fig. 2.—*Longitudinal Section of Brain of Frog.*

1, *2*, Lateral ventricles, or chambers of the hemispheres; *3*, Chamber of optic thalmus, or third ventricle: *4*, Chamber of cerebellum; *5*, Fourth ventricle; *as*, Aquæductus Silvii.

Fig. 3.—*Brain of Fish. (Polypterus.)*

A, From above; *B*, From the side; *O*, Olfactory lobes; *H*, Hemisphaees; *Th*, Optic thalmi; *Lo*, Lobi optici; *Ce*, Cerebellum; *Mo*, Medula oblongata.

Fig. 4.—*Brain of Human Fœtus, at seven months.*

F, Frontal lobe; *P*, Parietal lobe; *O*, Occipital lobe; *T*, Temporal lobe; *S*, Fissura Silvii; *R*, Sulcus of Rolando; *MO*, Medula; *C*, Cerebellum.

Fig. 9.—*Sensory apparatus in the Probosis of Fly.*

n, Nerve; *g*, Ganglion cell; *r*, Tactile rods.

Fig. 18.—*Diagram of the Course of Nerve Fibres*, passing from the retina to the brain.

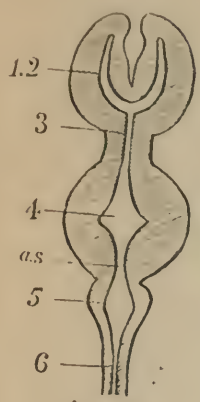


Fig. 2.

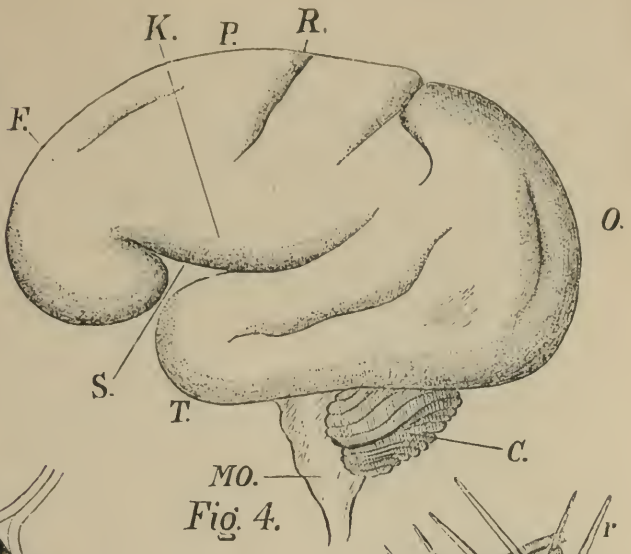
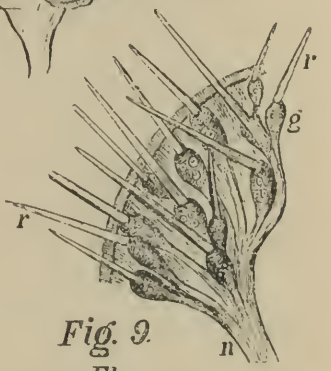


Fig. 4.

Fig. 18.



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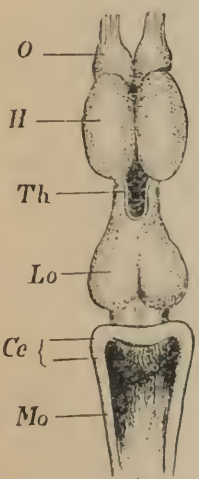

A

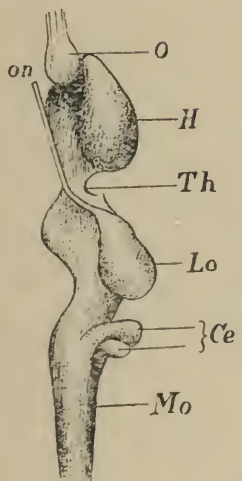

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Fig. 3.

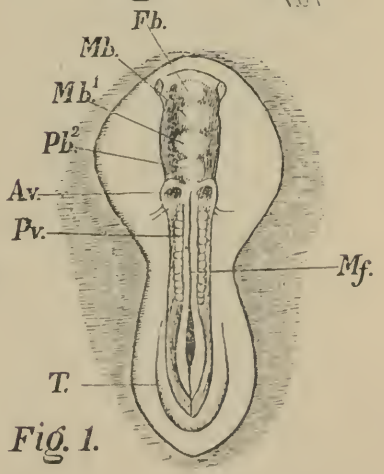


Fig. 1.

PLATE II.

Fig. 10.—*Tactile bodies.*

A, *B*. Tactile spheres from the bill of a duck; *C*, Tactile body imbedded in papilla of human skin: *e*, Epidermis; *n*, Nerve; *s*, Tactile body.

Fig. 11.—*A*. An epithelium cell with two olfactory cells. from Proteus; *g*, ganglionic portion of olfactory cell; *B*, Epithelium and olfactory cells of man.

Fig. 12.—*Gustatory Cup from Mouth of Rabbit.*

A, Entire; *B*, Isolated sensory cells from such a cup.

Fig. 13.—*Diagrams of the Development of the Labyrinth* in *(A)* Fishes, *(B)* Birds, *(C)* Mammals; *U*, Utriculus; *S*, Sacculus; *C*, Cochlea; *R*, Recessus labyrinthi.

Fig. 14.—*Eye of Spider in Section.*

L. Lense; *e*, Epidermal layer; *s*, Rods; *g*, Ganglion cells; *p*, Pigment.

Fig. 15.—*Diagramatic Section of the Eye of Nautilus.*

R, Retina; *o n*, Optic nerve.

Fig. 16.—*Diagramatic Section of the Eye of a Cuttle-fiish.*

L, L^2, Lenses; *el* Eye-lids; *R*, Retina; *og*, Optic ganglion; *on*, Optic nerve; *int*, Integument.

Fig. 17.—*Section of Human Retina.*

i, Membrana limitans interna; g^1, Ganglion layer; g^2, Second ganglion layer; g^3, Third layer of ganglion cells; *b*, b^1, Granular layers; *a*, Rod and spindle layer; *e*, External pigment layer.

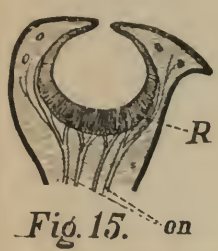


Fig. 15.

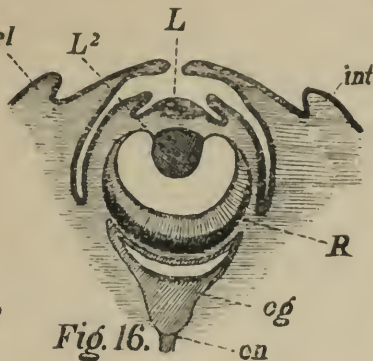


Fig. 16.

Fig. 14.

Fig. 10. A

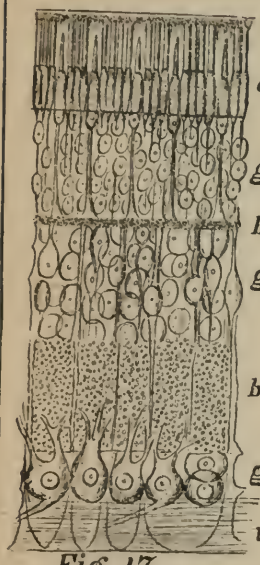


Fig. 17.

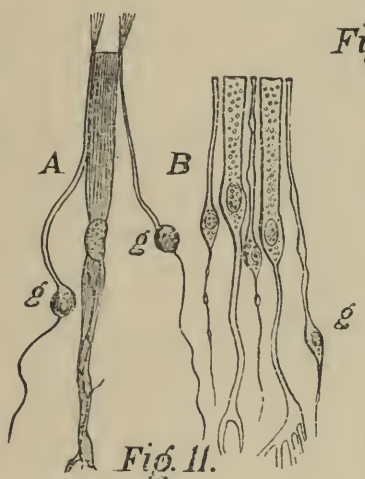


Fig. 11.

B Fig. 10.

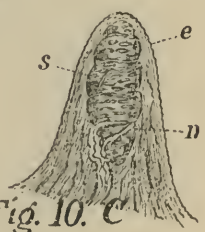
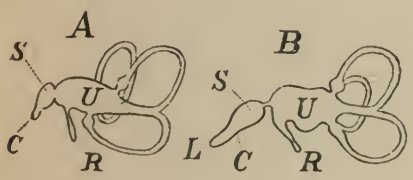


Fig. 10. C



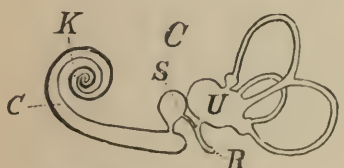
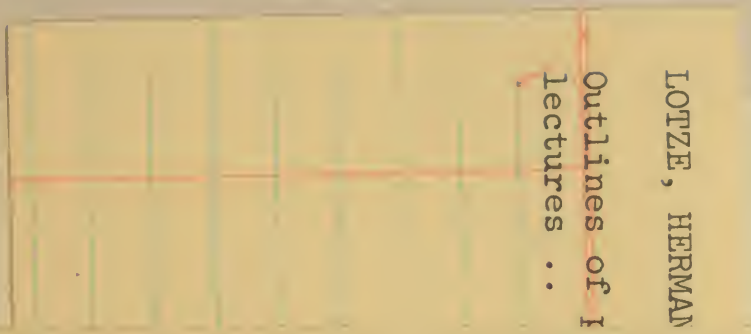


Fig. 13.

Fig. 12. A

Fig. 12. B



LOTZE, HERMANN

Outlines of psychology, dictations from lectures..